Installation Manual

MDKBK, MDKBL
MDKBM, MDKBN
MDKBP, MDKBR
MDKBS

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California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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SAFETY PRECAUTIONS

Thoroughly read the OPERATOR'S MANUAL before operating the genset. Safe operation and top performance can only be obtained when equipment is operated and maintained properly.

The following symbols in this manual alert you to potential hazards to the operator, service person and equipment.

⚠ DANGER ***alerts you to an immediate hazard that will result in severe personal injury or death.***

⚠WARNING ***alerts you to a hazard or unsafe practice that can result in severe personal injury or death.***

⚠ CAUTION ***alerts you to a hazard or unsafe practice that can result in personal injury or equipment damage.***

Electricity, fuel, exhaust, moving parts and batteries present hazards which can result in severe personal injury or death.

GENERAL PRECAUTIONS

- Keep children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- Do not step on the genset when entering or leaving the generator room. Parts can bend or break leading to electrical shorts or to fuel, coolant or exhaust leaks.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (–) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.
- Keep the genset, drip pan and compartment clean. Oily rags can catch fire. Gear stowed in the compartment can restrict cooling.
- Make sure all fasteners are secure and properly torqued.
- Do not work on the genset when mentally or physically fatigued or after having consumed alcohol or drugs.
- You must be trained and experienced to make adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to shore power or to any other source of electrical power. Back-feed to shore power can cause electric shock resulting in severe personal injury or death and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Never sleep in the boat while the genset is running unless the boat is equipped with properly working carbon monoxide detectors.
- The exhaust system must be installed in accordance with the genset Installation Manual and be free of leaks.
- Make sure the bilge is adequately ventilated with a power exhauster.
- Inspect for exhaust leaks every startup and after every eight hours of operation.
- For more information about carbon monoxide see American Boat and Yacht Council (ABYC) publication TH-22—*Educational Information About Carbon Monoxide.*

DIESEL FUEL IS COMBUSTIBLE

- Do not smoke or turn electrical switches ON or OFF where fuel fumes are present or in areas sharing ventilation with fuel tanks or equipment. Keep flames, sparks, pilot lights, arc-producing equipment and all other sources of ignition well away.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses.
- Do not smoke.
- To reduce arcing when disconnecting or reconnecting battery cables, always disconnect the negative (–) battery cable first and reconnect it last.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not wear loose clothing or jewelry near moving parts such as PTO shafts, fans, belts and pulleys.
- Keep hands away from moving parts.
- Keep guards in place over fans, belts, pulleys, and other moving parts.

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. ***Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc.*** The owners and operators of the genset are solely responsible for operating the genset safely.

POST THESE SAFETY PRECAUTIONS IN POTENTIAL HAZARD AREAS OF THE BOAT

M-10

1. Introduction

ABOUT THIS MANUAL

This manual is a guide for the installation of the generator sets (gensets) listed on the front cover. Proper installation is essential for top performance. Read through this manual before starting the installation.

This manual addresses the following aspects of the installation:

- Location and mounting
- Engine exhaust discharge and silencing
- Engine cooling
- Genset room ventilation
- Fuel connections
- Electrical connections
- Batteries
- Bonding for grounding
- Accessibility for operation and maintenance
- Noise and vibration.

⚠WARNING ***This genset is not a life support system. It can stop without warning. Children, persons with physical or mental limitations, and pets could suffer personal injury or death. A personal attendant, redundant power or an alarm system must be used if genset operation is critical.***

See the genset Operator's Manual for operation and maintenance and the Service Manual for service.

Note: Manuals are updated from time to time to reflect changes in the equipment and its specifications. For this reason, only the copy of the installation manual supplied with the genset should be used as a guide for the installation.

STANDARDS FOR SAFETY

You must find out which standards for safety are applicable. Compliance with United States Coast Guard (USCG) regulations is mandatory for boats in U. S. waters. The American Boat and Yacht Council (ABYC) and the National Fire Protection Association (NFPA) are typical of agencies that publish safety standards for the construction and installation of marine equipment. It is suggested that you obtain the following standards:

- USCG regulations are under Titles 33 and 46 of the Code of Federal Regulations (CFR),

  U.S. Government Printing Office
  Washington, D.C. 20404.

- NFPA No. 302, *Pleasure and Commercial Motor Craft,*

  National Fire Protection Association
  Batterymarch Park
  Quincy, MA 02269

- *Standards and Recommended Practices For Small Craft,*

  *A*merican Boat and Yacht Council, Inc.
  3069 Solomons Island Road
  Edgewater, MD 21037

Particular attention should be paid to ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Machinery,* ABYC E-11, *AC and DC Electrical Systems on Boats and ABYC A-27, Alternating Current (AC) Generator Sets*.

OUTLINE DRAWINGS

See the applicable OUTLINE DRAWING (p. A-4 and following) for installation details: mounting bolt hole locations, connection points (fuel, battery, raw water, exhaust, remote control and AC output), sizes and types of fittings, overall dimensions, etc. See your Onan® dealer for large-scale copies of the applicable drawings.

⚠WARNING ***Improper installation can result in severe personal injury, death and equipment damage. The installer must be qualified to perform installation of electrical and mechanical equipment.***

2. Location and Mounting

The genset has a single lifting eye, which is accessible through an access cover if the genset has an enclosure. Refer to the applicable OUTLINE DRAWING (p. A-4 and following) for the weight of the genset and make provisions accordingly for safe handling.

LOCATION

See the other sections titled *Ventilation*, *Fuel Supply, Engine Cooling* and *Engine Exhaust* for additional considerations that bear on location.

The genset is not "ignition protected" and therefore not permitted under USCG regulation 33CFR183 to be located in a gasoline fuel environment. If the boat has gasoline-fueled propulsion engines, the genset will have to be located where it can be isolated from the gasoline fuel system by approved methods.

⚠WARNING ***The genset can ignite gasoline fumes causing severe personal injury or death. Approved methods must be used to isolate the genset from a gasoline fuel environment.***

Because of noise, vibration and fumes, the generator compartment should be located as far from living quarters as practical.

Locate the genset where there will be enough room to perform periodic maintenance and service. Non-service sides should have at least 2 inches (50 mm) of clearance. The front should have at least 4 inches (100 mm) of clearance for air flow in and the right side at least 2 inches (50 mm) for air flow out. See the applicable OUTLINE DRAWING (p. A-4 and following).

Make sure there is access for:

- Starting and stopping the genset
- Resetting the line circuit breakers (when provided)
- Checking, filling and draining engine oil
- Changing the engine oil filter
- Changing the fuel filter
- Checking, filling and draining engine coolant
- Making fuel connections
- Making battery and ground connections
- Replacing coolant and exhaust hoses
- Replacing the raw water pump impeller (when provided)
- Replacing the V-belt

MOUNTING

The genset has integral vibration isolators. The supporting structure underneath should be level and able to support the weight of the genset. Floor or frame stiffness should be greatest under the vibration isolators. Secure the genset with four bolts. See the applicable OUTLINE DRAWING (p. A-4 and following) for the locations of the mounting bolt holes.

3. Ventilation

⚠WARNING ***EXHAUST GAS IS DEADLY—FUEL VAPORS ARE EXPLOSIVE! Failure to provide proper ventilation can result in asphyxiation, fire and explosion. The ventilation system must meet applicable standards and regulations, including USCG, NFPA and ABYC (p. 1-1).***

VENTILATION

Ventilation is required to prevent dangerous concentrations of fuel vapors and exhaust fumes, hold down compartment temperatures and provide combustion air. The highest compartment temperatures can occur just after the boat has been docked and the engines have been shut down.

To promote natural convective flow, good air exchange and fresh air for combustion and generator cooling, ventilating air should enter near the bottom of the compartment at the front near the air inlet and exit near the top at the right side. The free-air area of the inlet air cowl should be at least twice that of the duct. Use 40 in^2 (258 cm^2) as the basis for calculations for inlet and outlet air duct sizes and free-air areas of screens and louvers. Do not use flush air inlets or louvered transom outlets, which are easily blocked.

Operating a genset in ambient temperatures above 104° F (40° C) will result in noticeable loss of power. Operating a genset in ambient temperatures higher than 122° F (50° C) will reduce the life of electrical components, generator windings, rubber and other construction materials.

When calculating air flow required for combustion and ventilation, refer to *Section 10. Specifications* for data regarding air flow and heat radiated to the room.

CARBON MONOXIDE

All openings and feed-through holes for wiring, conduit, pipe and hose must be sealed to prevent exhaust gases from entering the rest of the boat. Wiring conduit must be sealed inside as well as outside.

Cabin plumbing drains must have approved traps to prevent the entrance of exhaust gases from outside.

Carbon monoxide (CO) detectors, listed for marine applications, should be installed in the living quarters of the boat. Wind shifts, boat motion, exhaust from other boats at dockside and other conditions can cause exposure to harmful concentrations of carbon monoxide even when proper ventilation is provided and living quarters are sealed off from engine rooms.

4. Fuel Connections

⚠WARNING ***Improper storage and handling of Diesel Fuel can lead to fire. Fuel tank construction, location, installation, bonding for grounding, ventilation, piping, inspection and leak testing must be in accordance with applicable standards and regulations, including USCG, NFPA and ABYC (p. 1-1).***

⚠CAUTION ***Do not use galvanized fuel tanks or piping. The trace of sulfur in diesel fuel attacks galvanized (zinc) coatings causing debris that can clog fuel filters, pumps and injectors.***

Fuel

See the Operator's Manual for recommended fuel.

Fuel Filters

The genset is equipped with a water-separator fuel filter. It is recommended that a 10 to 30 micron water-separator fuel filter be installed in the fuel supply system to protect the fuel lift pump.

Fuel Fittings

Two 1/4-18 NPTF fittings are provided for fuel supply and return connections. See the appropriate OUTLINE DRAWING (p. A-4 and following). Fuel hose adapter fittings are available from Onan.

Fuel Hoses

Use USCG TYPE A1 or ISO 7840-A1 fuel hoses. See Fuel Line Sizing in this section for recommended sizing.

The fuel hoses connected at the genset must be non-conductive so that the fuel lines do not become paths for cranking current. (Because the fuel tanks are required to be bonded to the common negative [–] grounding system of the boat, conductive fuel lines connected directly to the genset will carry cranking currents.)

⚠WARNING ***Fire can result when fuel lines carry cranking current. Use non-conductive fuel hoses for connections at the genset to prevent the fuel lines from becoming paths for cranking current.***

Fuel Line Sizing

An inside diameter of 5/16 inch (8 mm) is recommended for fuel lines and hoses. An inside diameter of 1/4 inch (7 mm) should be considered in applications where fuel lines are short and lift minimal. See Fuel Lift in this section. *Larger diameter fuel lines are harder to prime and keep primed and are thus more likely to cause disruption of genset service.*

Run fuel lines as directly as possible avoiding dips and crests that trap air and cause hard priming.

Fuel Pickup Tube

A separate fuel pickup tube and supply line is recommended for each genset. Shared pickup tubes and distribution manifolds can lead to fuel starvation and difficult priming.

See Fuel Line Sizing in this section for recommended sizing.

In a common fuel supply tank the genset pickup tubes should be shorter than the propulsion engine pickup tubes to prevent the gensets from being able to empty the fuel tanks.

Make sure the fuel tanks are large enough to cool the returning fuel.

Fuel Shutoff Valves

A fuel shutoff valve is required at the fuel tank if the end of the fuel line is located below the highest level of fuel in the tank.

An approved method is required to prevent flow when the engine is not running if the highest level of fuel in the supply tank is above the fuel injectors.

Fuel Lift

The fuel lift pump on the genset has a fuel lift capability (suction) of 4 feet (1.2 meters). Note that the pump must overcome the resistance to fuel flow in hoses, tubing, fittings, valves and filters as well as the actual lift in elevation.

5. Engine Cooling

The engine is cooled by a pressurized, closed-loop liquid cooling system in which coolant is pumped through passages in the engine block, head and exhaust manifold (Figure 5-1 or 5-2). Heat is carried away from the coolant by a keel cooler or raw water (sea water) heat exchanger. A gear-driven raw water pump is provided if the genset has a heat exchanger or wet exhaust. See the appropriate OUTLINE DRAWING (p. A-4 and following) for connection points and fitting sizes.

SYSTEM COMPONENTS

Raw Water Pump

The raw water pump can deliver the required flow of cooling water against a maximum lift (suction) of 4 feet (1.22 meters). Lift is a combination of the actual vertical lift and the resistance to flow caused by the hoses, strainer, sea cock and through-hull fitting.

Raw Water Hose

Use SAE 20R4 or equivalent hose that is able to resist a slight vacuum without collapsing. The fitting on the raw water pump inlet is sized for 1 inch (25.4 mm) internal diameter hose. This size should be used for all hoses and pipes in the raw water pick-up line.

Raw Water Strainer

The raw water strainer should be located below and as close to the raw water pump as practical. The basket must be removeable for cleaning. *Fill the sea water strainer for faster priming at startup if it is above the water line.*

Sea Cock

Install a bronze, full-flow sea cock on the through-hull fitting.

Through-Hull Fitting and Strainer

The through-hull fitting should be as close to the genset as possible. If the strainer has slotted openings, the slots must be parallel to the keel for best flow when the boat is under way. Through-hull fittings should be staggered along the keel so that downstream fittings are not starved.

⚠ CAUTION ***Do not use a scoop-type through-hull fitting. A forward-facing scoop can develop enough ram pressure to flood the engine. A rear-facing scoop can develop enough suction to impede flow.***

Siphon Break

⚠ CAUTION ***Engine damage due to flooding as a result of failing to install a required siphon break is not covered by Warranty.***

Conduct the RAW WATER PICKUP TEST to determine whether a siphon break is required to prevent the muffler and engine from being flooded with floatation water (Figure 6-2). The top panel of an enclosed genset has knockouts for the hoses to pass through. A siphon break kit is available from Onan. The kit has hole grommets.

To keep leaks from spilling on the genset, do not mount the siphon break directly above the genset.

Coolant Recovery Tank

The coolant recovery tank kit shipped with the genset must be installed for proper operation of the cooling system. Follow the instructions in the kit.

The tank must be accessible for daily inspection and refilling. The genset enclosure (if provided) has holes for mounting the tank on the engine end. For gensets not provided with an enclosure, mount the tank on a bulkhead within reach of the hoses and slightly above or at the same height as the pressure cap. Fill the tank in accordance with the Operator's Manual.

Initial Coolant Fill

⚠ CAUTION ***Running the engine without coolant can cause damage not covered by Warranty.***

The genset is normally shipped from the factory with coolant, unless prohibited by shipping regulations. Fill the system, if necessary, in accordance with the Operator's Manual.

Note: Keel-cooled gensets are only partially filled with coolant. Coolant must be added to fill the keel cooler and expansion tank.

RAW WATER PICKUP TEST

Objective

The objective is to determine the elevation of the water line relative to the genset under all anticipated uses and speeds of the boat.

Method

When the boat is ready for its sea trials and loaded to its maximum rated capacity:

1. Close the sea cock and disconnect the raw water pickup hose from the genset. Alternatively, connect a clear plastic hose to the strainer or sea cock.
2. Raise the end of the hose above expected water level and open the sea cock. *The water line is at the level visible in a clear plastic hose or where water just begins to spill as the end of the hose is lowered.* While the boat is still docked, mark the level on the genset enclosure.
3. Operate the boat through its speed range, forward and reverse. While the boat is operating, have someone monitor the water level in the hose and mark the highest level on the genset.

Requirement

A siphon break must be installed if the engine exhaust-water mixer (Figure 6-2) is not at least 6 inches (152 mm) above both water lines (docked and moving).

Note: If the water line when the boat is moving is much higher than when the boat is docked, the difference could be due to the through-hull fitting or its location. If the through-hull fitting is of the forward-facing scoop-type designed to create ram pressure, replace it with a flush-type fitting. Another possibility might be to move the fitting to a location where the dynamic hull pressure is less.

KEEL COOLING

When sizing the keel cooler, refer to *Section 10. Specifications* for data regarding fitting sizes, engine coolant capacity, thermostat opening temperature, coolant flow rate, heat rejection to coolant and maximum coolant friction head.

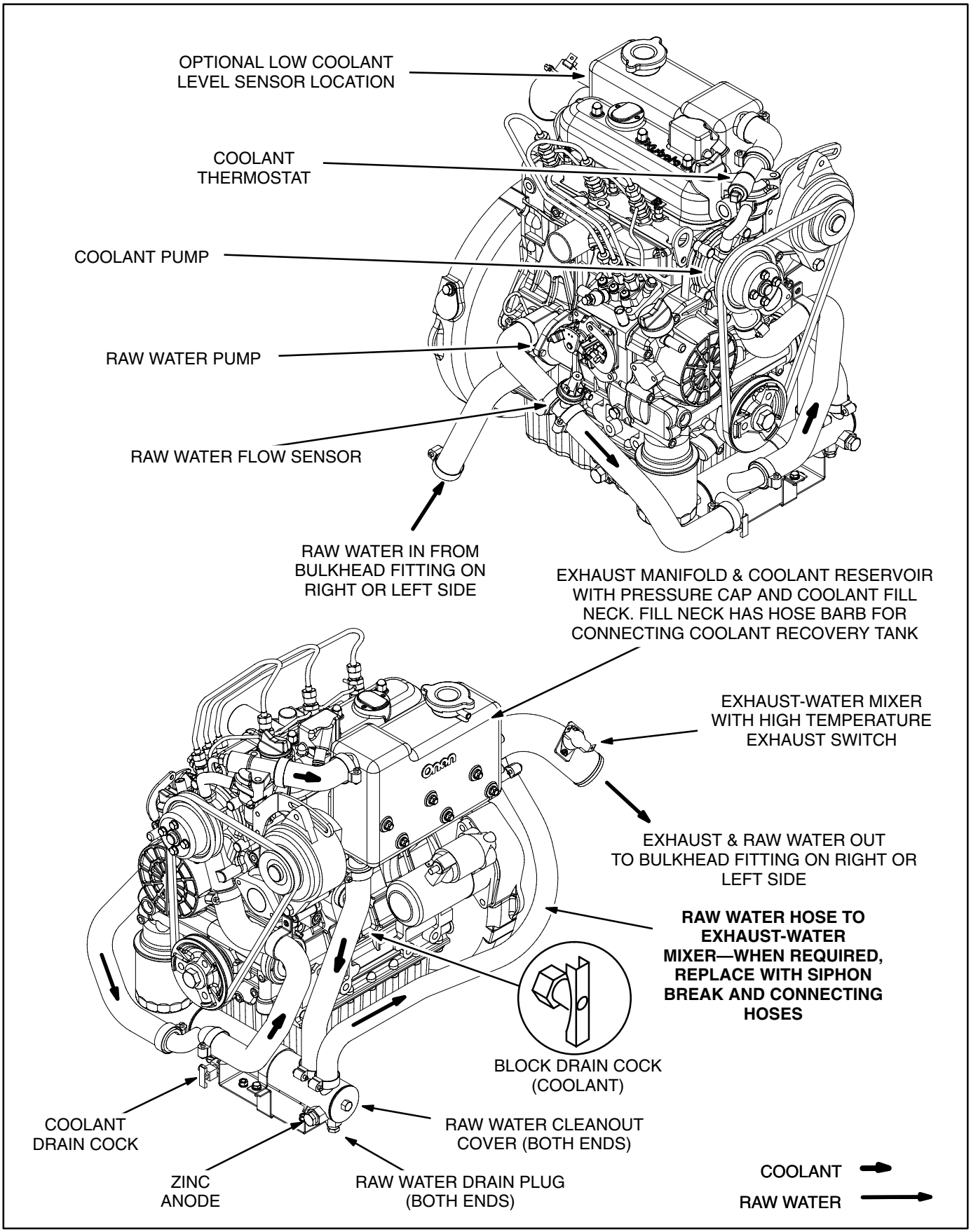

OPTIONAL LOW COOLANT LEVEL SENSOR LOCATION
COOLANT THERMOSTAT
COOLANT PUMP
RAW WATER PUMP
RAW WATER FLOW SENSOR
RAW WATER IN FROM BULKHEAD FITTING ON RIGHT OR LEFT SIDE
EXHAUST MANIFOLD & COOLANT RESERVOIR WITH PRESSURE CAP AND COOLANT FILL NECK. FILL NECK HAS HOSE BARB FOR CONNECTING COOLANT RECOVERY TANK
EXHAUST-WATER MIXER WITH HIGH TEMPERATURE EXHAUST SWITCH
EXHAUST & RAW WATER OUT TO BULKHEAD FITTING ON RIGHT OR LEFT SIDE
RAW WATER HOSE TO EXHAUST-WATER MIXER—WHEN REQUIRED, REPLACE WITH SIPHON BREAK AND CONNECTING HOSES
BLOCK DRAIN COCK (COOLANT)
COOLANT DRAIN COCK
RAW WATER CLEANOUT COVER (BOTH ENDS)
ZINC ANODE
RAW WATER DRAIN PLUG (BOTH ENDS)
COOLANT
RAW WATER

FIGURE 5-1. ENGINE COOLING SYSTEM—MDKBK, MDKBL, MDKBM, MDKBN

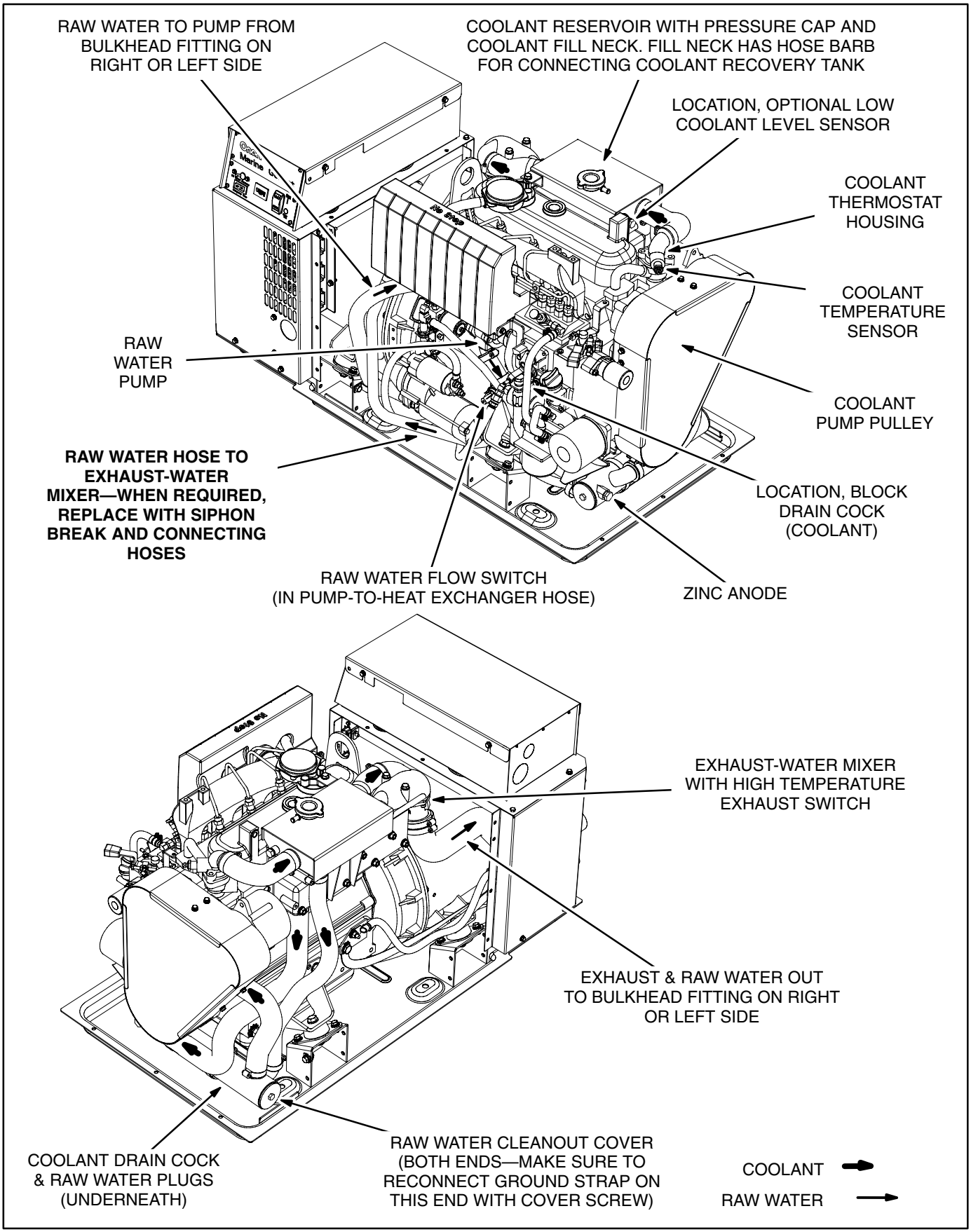

RAW WATER TO PUMP FROM BULKHEAD FITTING ON RIGHT OR LEFT SIDE
COOLANT RESERVOIR WITH PRESSURE CAP AND COOLANT FILL NECK. FILL NECK HAS HOSE BARB FOR CONNECTING COOLANT RECOVERY TANK
LOCATION, OPTIONAL LOW COOLANT LEVEL SENSOR
COOLANT THERMOSTAT HOUSING
COOLANT TEMPERATURE SENSOR
RAW WATER PUMP
COOLANT PUMP PULLEY
RAW WATER HOSE TO EXHAUST-WATER MIXER—WHEN REQUIRED, REPLACE WITH SIPHON BREAK AND CONNECTING HOSES
LOCATION, BLOCK DRAIN COCK (COOLANT)
RAW WATER FLOW SWITCH (IN PUMP-TO-HEAT EXCHANGER HOSE)
ZINC ANODE
EXHAUST-WATER MIXER WITH HIGH TEMPERATURE EXHAUST SWITCH
EXHAUST & RAW WATER OUT TO BULKHEAD FITTING ON RIGHT OR LEFT SIDE
COOLANT DRAIN COCK & RAW WATER PLUGS (UNDERNEATH)
RAW WATER CLEANOUT COVER (BOTH ENDS—MAKE SURE TO RECONNECT GROUND STRAP ON THIS END WITH COVER SCREW)
COOLANT
RAW WATER

FIGURE 5-2. ENGINE COOLING SYSTEM—MDKBP, MDKBR, MDKBS

6. Engine Exhaust

WET EXHAUST SYSTEMS

⚠WARNING ***EXHAUST GAS IS DEADLY! The exhaust system must be leak-free and convey all exhaust outside, away from windows, doors and vents.***

Figure 6-1 illustrates a typical exhaust system where the raw water fitting on the exhaust-water mixer (siphon point) is above the load water line and Figure 6-2 where it is below. See *Engine Cooling* (Page 5-1) regarding raw water connections. The installation must comply with applicable standards and regulations, including those of the USCG and ABYC (p. 1-1)

A separate engine exhaust system must be installed for each genset. It must be isolated from all other engine exhaust systems.

Mufflers, water separators and siphon breaks are available as kits from Onan.

Hose and Hose Fitting Diameters

No hose or hose fitting in the exhaust system may have a smaller inside diameter than the engine outlet. If the total run of exhaust hose is more than 20 feet (6 meters), measure exhaust back pressure and use larger diameter hose if back pressure exceeds specifications. See *Section 10. Specifications*.

Exhaust Hose

Use hose that has been approved for wet exhaust systems. Approved hose and stainless steel elbows are available from Onan. Horizontal runs of hose must slope down at least 1/2 inch per foot (42 mm/meter) and be supported such that there are no sags. *The entire run of hose must be accessible for regular, visual inspections and replacement*.

Hose Clamps

Use two stainless steel hose clamps at least 1/2 inch (12.7 mm) wide to clamp each end of each hose.

Muffler

Install an approved muffler as close a practical to the engine. For optimum silencing, the length of hose between the engine and muffler should not exceed 6 feet (2 meter). The muffler inlet should be a minimum of 1 foot (305 mm) below the exhaust-water mixer and the outlet should be vertical.

The base of the muffler should not be more than 54 inches (1.4 meter) below the water separator (Figure 6-1) or 48 inches (1.2 meter) below the crest in the piping (Figure 6-2).

Mount the muffler such that air can circulate underneath to prevent condensation and mold.

Exhaust Water Separator

When an exhaust water separator is used (Figure 6-1), *the muffler outlet and water separator inlet diameters must be the same size.* The water separator should be installed directly above the muffler to maintain a vertical lift. The through-hull fitting for the drain hose should be below the load water line and must have a sea cock. An EXHAUST WATER SEPARATOR BACKFLOW TEST must be conducted during the sea trials to determine that there is no backflow that could flood the engine.

Exhaust Through-Hull Fitting

The exhaust through-hull fitting must be above the load water line under all anticipated uses and speeds of the boat. To reduce wave wash-in when a water separator is used (Figure 6-1), the top of the water separator must be at least 18 inches (450 mm) *above the load water line*. When an elbow is used at the top of the muffler outlet hose, the elbow must be at least 12 inches (305 mm) above the through-hull fitting (Figure 6-2).

⚠ CAUTION ***Backflow can cause major engine damage if the cylinders become flooded. The sea trials must verify that there is no backflow through either the exhaust hull fitting or the water separator drain hose fitting.***

Siphon Break

See Page 5-1.

EXHAUST WATER SEPARATOR BACKFLOW TEST

Objective

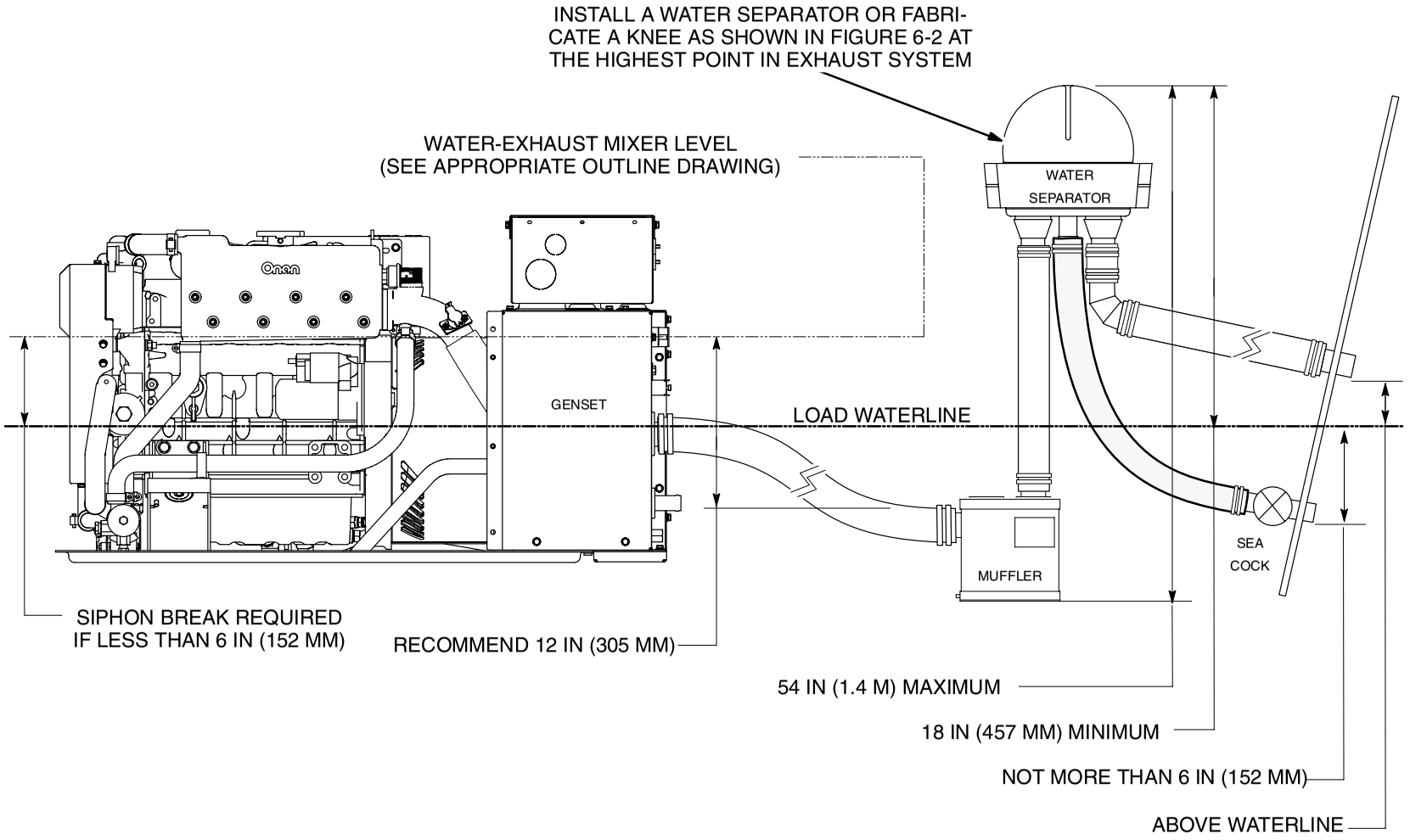
To determine that there is no backflow through the exhaust water separator under any operating condition (Figure 6-1).

Method

Conduct this test during the sea trials in conjunction with the RAW WATER PICKUP TEST. Prepare by closing the drain hose sea cock and disconnecting the hose from the water separator. Conduct the test by opening the sea cock while keeping the hose raised to its fitting on the water separator.

Requirement

There must not be any back flow while operating the boat throughout its speed range. If there is, relocate the through-hull fitting.

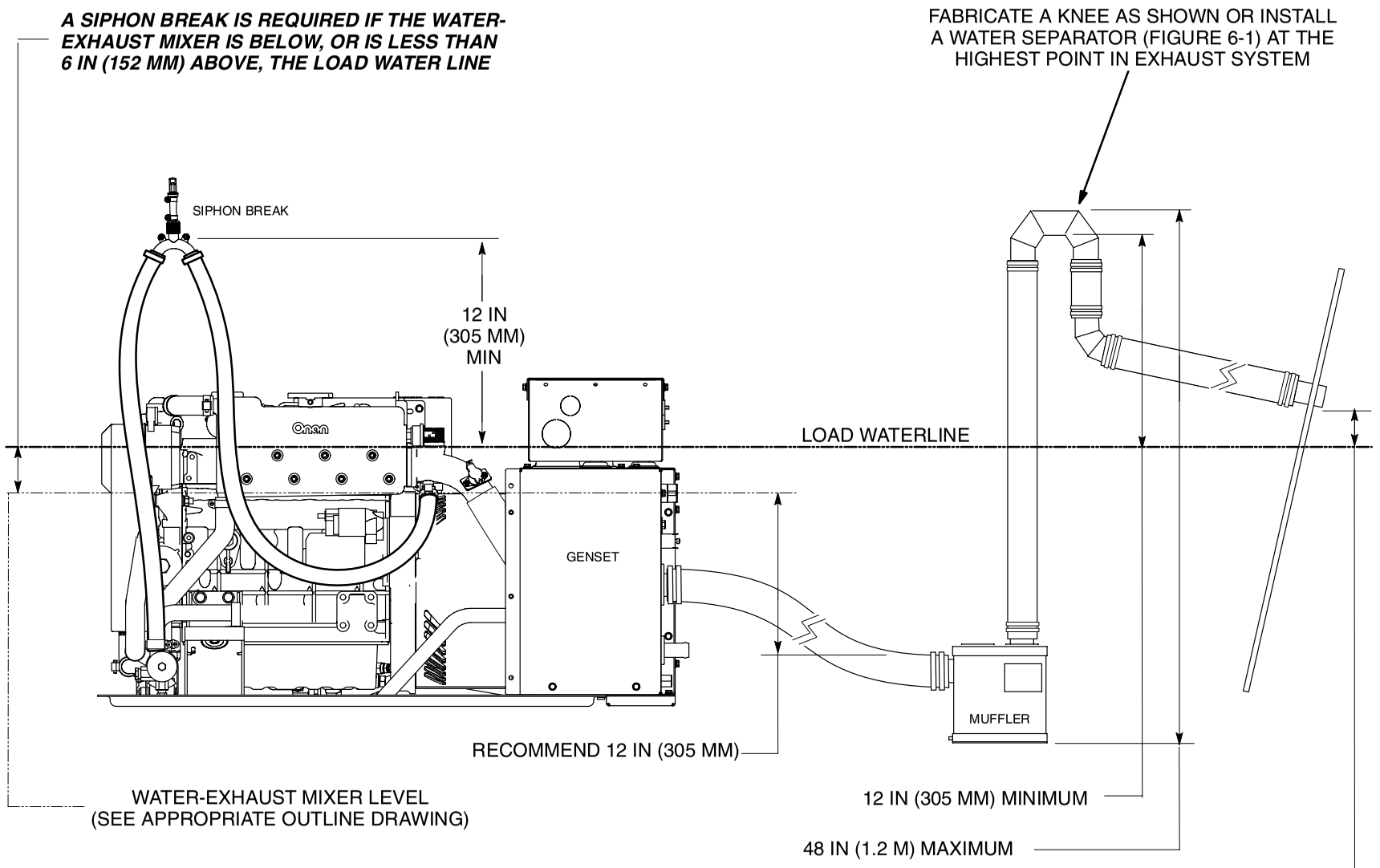

INSTALL A WATER SEPARATOR OR FABRICATE A KNEE AS SHOWN IN FIGURE 6-2 AT THE HIGHEST POINT IN EXHAUST SYSTEM
WATER-EXHAUST MIXER LEVEL (SEE APPROPRIATE OUTLINE DRAWING)
WATER SEPARATOR
GENSET
LOAD WATERLINE
MUFFLER
SEA COCK
SIPHON BREAK REQUIRED IF LESS THAN 6 IN (152 MM)
RECOMMEND 12 IN (305 MM)
54 IN (1.4 M) MAXIMUM
18 IN (457 MM) MINIMUM
NOT MORE THAN 6 IN (152 MM)
ABOVE WATERLINE

Notes:

1. All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

2. The operator will not be able to look for water discharge from the hull to tell whether engine/exhaust cooling water is flowing. However, the genset will shut-down if water stops flowing (Code No. 7) or exhaust temperature rises because of loss of water (Code No. 58). See *Troubleshooting* in the Operator's Manual.

FIGURE 6-1. TYPICAL WET EXHAUST INSTALLATION ABOVE LOAD WATERLINE—WITH WATER SEPARATOR


A SIPHON BREAK IS REQUIRED IF THE WATER-EXHAUST MIXER IS BELOW, OR IS LESS THAN 6 IN (152 MM) ABOVE, THE LOAD WATER LINE
FABRICATE A KNEE AS SHOWN OR INSTALL A WATER SEPARATOR (FIGURE 6-1) AT THE HIGHEST POINT IN EXHAUST SYSTEM
SIPHON BREAK
12 IN (305 MM) MIN
LOAD WATERLINE
GENSET
MUFFLER
RECOMMEND 12 IN (305 MM)
WATER-EXHAUST MIXER LEVEL (SEE APPROPRIATE OUTLINE DRAWING)
12 IN (305 MM) MINIMUM
48 IN (1.2 M) MAXIMUM
ABOVE WATERLINE

Notes:

1. All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

FIGURE 6-2. TYPICAL WET EXHAUST INSTALLATION BELOW LOAD WATERLINE—WITH SIPHON BREAK

DRY EXHAUST SYSTEMS

Figure 6-3 shows a typical dry exhaust system. A separate exhaust system must be provided for each engine. Soot, corrosive condensate and high gas temperatures can damage idle engines served by a common exhaust system.

The exhaust system must be supported independently of the engine. Supporting the weight of exhaust piping at the turbocharger outlet can lead to turbocharger failure.

A flexible, bellows-type stainless steel section at least 18 inches (300 mm) long must be connected at the engine exhaust outlet to take up thermal expansion and engine movement.

Long runs of exhaust pipe (vertical or horizontal) should include a flexible, bellows-type stainless steel section to take up thermal expansion. Flexible exhaust sections must not be used to compensate for misaligned piping or for forming bends.

Horizontal runs of exhaust piping should slope downwards from the engine to a drain trap and plug, which should be located where the piping turns to rise vertically.

To prevent overheating that can lead to fire, route exhaust piping at least 9 inches (229 mm) away from combustible construction. Where a 9 inch (229 mm) clearance cannot be maintained, the pipe may be insulated with material rated to withstand at least 1000°F (538°C). The surface of the insulation must not exceed 160°F (71°C).

To prevent burns, shield or insulate exhaust piping and mufflers where accidental contact is likely. The surface of the shield or insulation must not exceed 200°F (93°C).

The entire exhaust system must be accessible for regular, visual inspection and repair.

See *Section 10. Specifications* for maximum allowable exhaust back pressure.

⚠CAUTION ***Excessive exhaust back pressure can result in reduced power, smoke, high exhaust temperature and reduced engine life.***

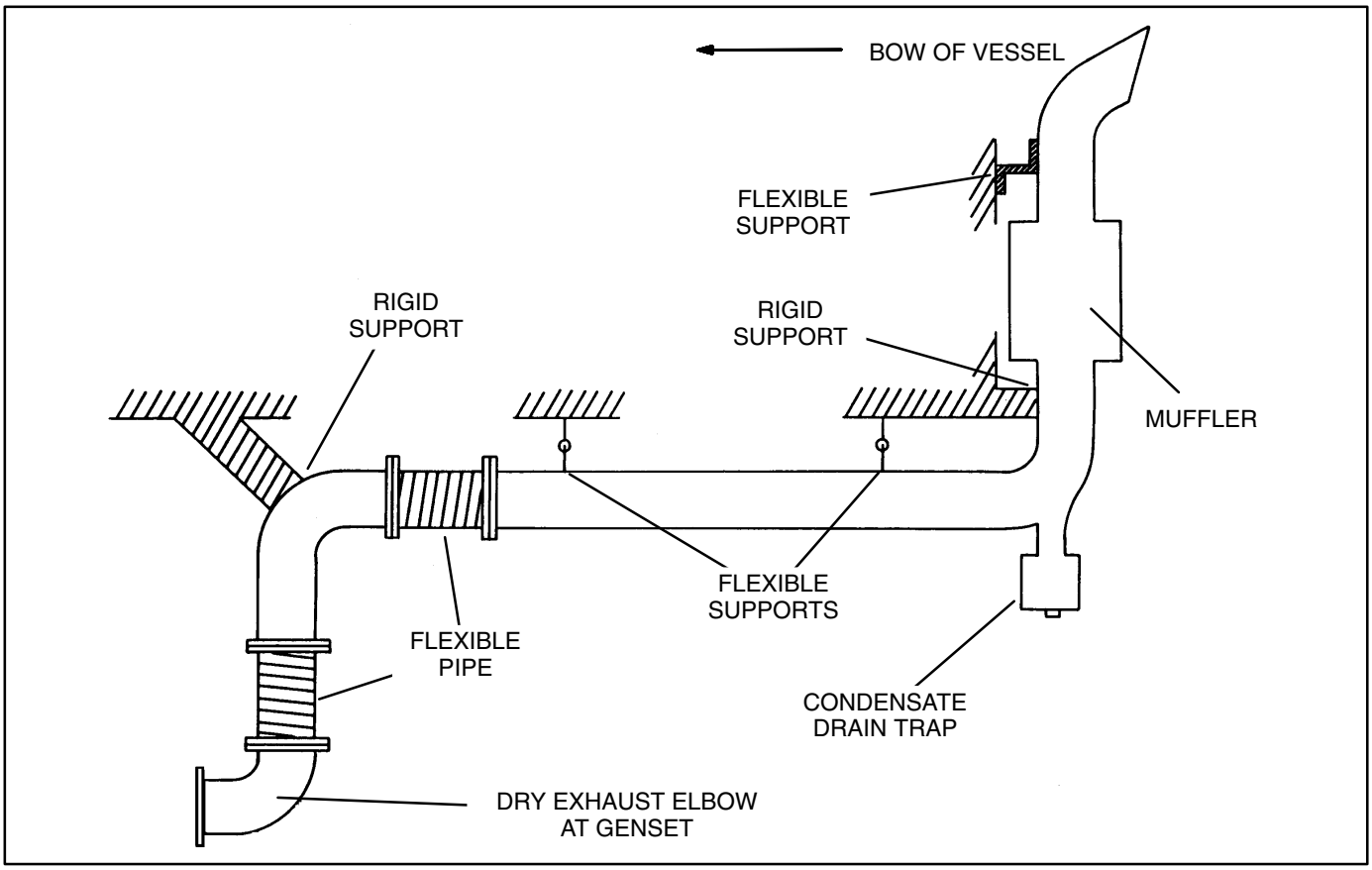


FIGURE 6-3. SCHEMATIC OF TYPICAL DRY EXHAUST SYSTEM

7. Electrical Connections

⚠WARNING ***HAZARDOUS VOLTAGE! Touching uninsulated live parts inside the genset and connected equipment can result in severe personal injury or death. For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and use tools with insulated handles. Secure protective covers when completing installation.***

IMPROPER WIRING can cause fire or electric shock resulting in severe personal injury or death.

ACCIDENTAL / REMOTE STARTING of the genset can cause severe personal injury or death. To prevent unintended starting, do not connect the starting battery until it is time to start up the genset.

AC CONNECTIONS

Wiring Methods

All wiring methods, connections, wire ampacities, equipment grounding and materials must be inspected and comply with applicable regulations. Use flexible conduit and stranded conductors for load wiring to take up movement and vibration.

Note: All feed-through holes in decks and bulkheads for wiring must be sealed to prevent exhaust gases and flammable vapors from entering the rest of the boat. Wiring conduit must be sealed inside as well as outside

Generator (Alternator) Connections

Make generator connections or reconnections as required in the AC box (Figure 7-1) in accordance with the appropriate reconnection diagram (p. A-2). See the appropriate OUTLINE DRAWING (p. A-4 and following) regarding wiring knockout sizes and locations.

The circuit breakers may need to be replaced to obtain required protection or full genset power if reconnections are made. Voltage may also need to be readjusted. See *Section 8. Adjusting AC Output Voltage.*

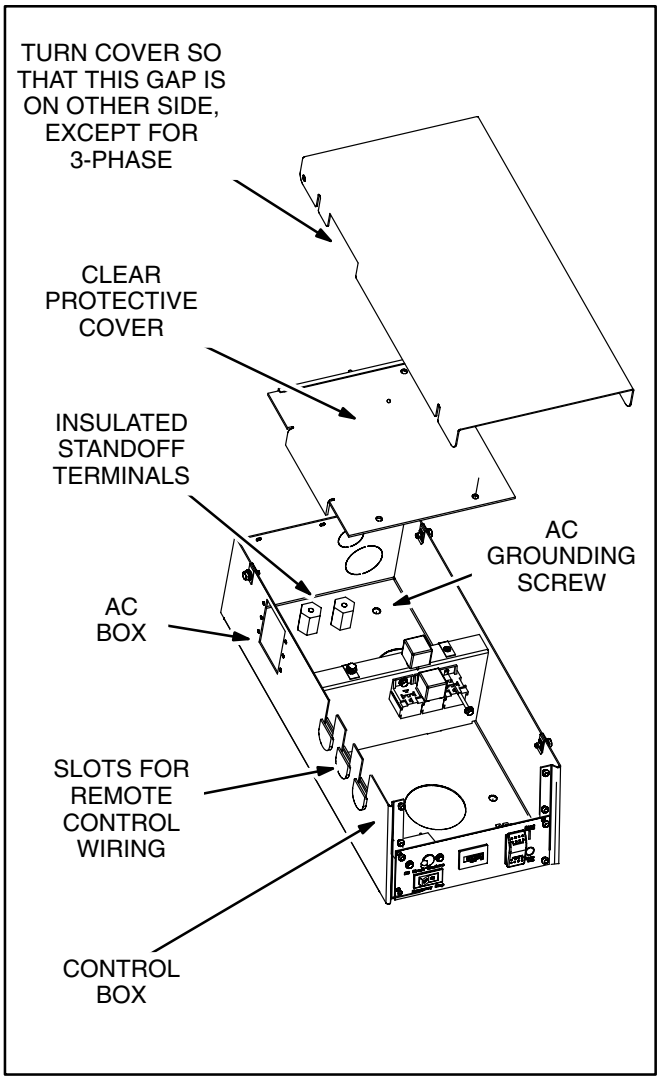

TURN COVER SO THAT THIS GAP IS ON OTHER SIDE, EXCEPT FOR 3-PHASE
CLEAR PROTECTIVE COVER
INSULATED STANDOFF TERMINALS
AC GROUNDING SCREW
AC BOX
SLOTS FOR REMOTE CONTROL WIRING
CONTROL BOX

FIGURE 7-1. TYPICAL AC / CONTROL BOX

Grounding

The genset, power supply wiring and all connected electrical equipment must be bonded to the common grounding system of the boat in accordance with applicable regulations.

⚠WARNING ***Faulty grounding of electrical equipment can lead to fire or electric shock resulting in severe personal injury or death.***

Transfer Switch

Use an approved transfer switch if provision is made for connecting the boat to shore power.

⚠WARNING ***Backfeed to shore power can cause electric shock resulting in severe personal injury or death and damage to equipment. Use an approved device to prevent the genset from being interconnected with shore power.***

Load Balancing

The electrical loads on the generator should be balanced as closely as possible between the AC output legs so that maximum power can be utilized from the genset. Redistribute the loads as necessary.

BATTERY CONNECTIONS

Depending on model, the genset requires negative (–) ground, 12 VDC or 24 VDC for its control and cranking systems. Some models are equipped for applications requiring an isolated ground.

Batteries

See *Section 10. Specifications* for recommended battery capacity.

Battery Recharging

See *Section 10. Specifications* for the battery charging capacity of the engine-driven battery charging alternator.

Battery Location and Mounting

Locate the battery where spills and leaks will not drip acid on fuel lines, wiring or other equipment and where ventilation is adequate to prevent the accumulation of explosive gases. Secure the battery so that it cannot shift and provide a boot over the positive (**+**) terminal to protect against accidental contact.

⚠WARNING ***Arcing can ignite the explosive hydrogen gas given off by the battery, causing severe personal injury. The battery compartment must be ventilated and isolated from spark-producing equipment.***

Battery Cables

Size battery cables according to Table 7-1. Total cable length is the sum of the lengths of the positive (**+**) and negative (**–**) cables. In other words, total cable length will be approximately twice the distance between the battery and the genset.

TABLE 7-1. BATTERY CABLE SIZES

TOTAL CABLE LENGTH, FEET (METERS)	CABLE SIZE, AWG
10 (3)	4
14 (4.3)	3
18 (5.5)	2
22 (6.7)	1
30 (9.1)	1/0

⚠WARNING ***Sparks can ignite fuel leading to severe personal injury or death. Do not run battery cables and fuel lines together. Separate cables and fuel lines with conduit or tubing if run through the same opening. Do not tie together.***

See the appropriate OUTLINE DRAWING (p. A-4 and following) regarding the battery cable terminal locations. Provide an insulating boot over the positive (**+**) terminal to protect against accidental contact.

GENSET GROUND (VESSEL BOND)

The genset must be bonded to the common grounding system of the boat in accordance with applicable regulations. Connect the bonding cable to the grounding lug beside the battery cable terminals.

⚠WARNING ***Faulty bonding of the genset to the common grounding system of the boat can result in severe personal injury or death.***

REMOTE CONTROL CONNECTOR

Connector **J4** for remote control connections is stowed inside the control box (p. A-1). It mates with a Deutsch® Part Number **DT06–08S** sealed 8-pin connector plug.

Note: The connector designated *J44* is for remote connections when the optional Network Interface Module (NIM) is mounted inside the genset control box. The connector designated *J34* is for remote connections when the *e*-Series Digital Display is mounted on the genset control box. See Page A-3 for connections.

Onan e-Series Digital Displays

Up to three (3) Onan *e*-Series Digital Displays may be connected for remote control and monitoring of the genset. Follow the installation instructions in the kit.

A kit is also available to replace the genset control switch panel with an *e*-Series Digital Display panel.

Remote Control Switch and Meter

Onan Remote Control Panel Kit: Remote control panels with a control switch or control switch and hour meter are available as kits. Follow the installation instructions in the kit.

Non-Onan Remote Control Panels: Refer to the wiring diagrams on Page A-3 to select and connect the remote control panel components. The Start-Stop switch must be momentary contact in both positions.

Remote Control Wiring Harnesses

Onan Harnesses: Eight-conductor plug-in wiring harnesses of various length are available for connecting *e*-Series Digital Displays and/or remote switch panels. “Y” harnesses are also available for applications requiring more than one remote control station.

Non-Onan Harnesses: Use 16 AWG wiring.

Note 1: All feed-through holes in decks and bulkheads for wiring must be sealed to prevent exhaust gases and flammable vapors from entering the rest of the boat. Wiring conduit must be sealed inside as well as outside.

Note 2: Do not route remote control wiring near AC wiring. AC can induce false signals that can cause erratic operation of the genset.

EXTERNAL CUSTOMER CONNECTIONS

The genset control box has factory jumpered leads with quick-connect terminals labeled **SWB+**, **ESTOP** and **CO** for connecting external genset shutdown devices. See the wiring diagram on Page A-3. Connect **ESTOP** to an emergency shut down system, such as for fire suppression, and **CO** to a CO detector. Leave the factory jumper connected if an external connection is not made, otherwise the genset cannot run.

The *e*-Series Digital Display will display **Code No. 5—SHUTDOWN DUE TO VESSEL CO** or **Code No. 61—EXTERNAL SHUTDOWN** if shutdown occurs. See *Troubleshooting* (Operator’s Manual).

Models with Option H647 (p. A-3) have a relay and connector (J14/P14) for connection to the external customer circuits. Leave connector P14 connected if an external connection is not made, otherwise the genset cannot run.

FREQUENCY SELECTION JUMPERS

The genset control box has jumper leads marked **HZ SEL** and **60 HZ**. Connect the two leads for **60 HZ** or disconnect for **50 HZ**.

OPTIONAL NETWORK INTERFACE MODULE (NIM)

The optional NIM board is mounted on the wall inside the control box. See Page A-3 for connections. It has an open 12-Pin connector socket for external network connections that mates with a Deutsch® Part Number **DT06–12S** sealed 12-pin connector plug.

Note 1: For *SAE 1939* applications see your Onan distributor for more information. Onan Publication *D-3315*, *Supported Messages on SAE J1939*, must be used in designing the interface for monitoring genset status and diagnostics.

Note 2: For *SmartCraft* applications see your Cummins MerCruiser Distributor for more information.

The NIM board has five jumpers to configure the board for the specific application (Figure 7-2).

1. Jumper **W1** has no function at this time.
2. Jumper **W2** will be cut when the genset is ordered for an *SAE J1939* network application. The jumper must remain uncut when the genset is ordered for a *SmartCraft* network application.
3. For *J1939* applications jumpers **W3** and **W4** are used to assign the network addresses of the gensets in a multiple-genset installation. To assign an address, cut the jumpers as scheduled in Table 7-2.

   For *SmartCraft* applications see your Cummins MerCruiser Distributor.

TABLE 7-2. J1939 ADDRESSES

JUMPER W3	JUMPER W4	ADDRESS
Not Cut	Not Cut	234
Not Cut	Cut	158
Cut	Not Cut	179
Cut	cut	203

4. Cut Jumper **W5** if the bus termination resistor on this NIM board is not required to terminate the network bus.

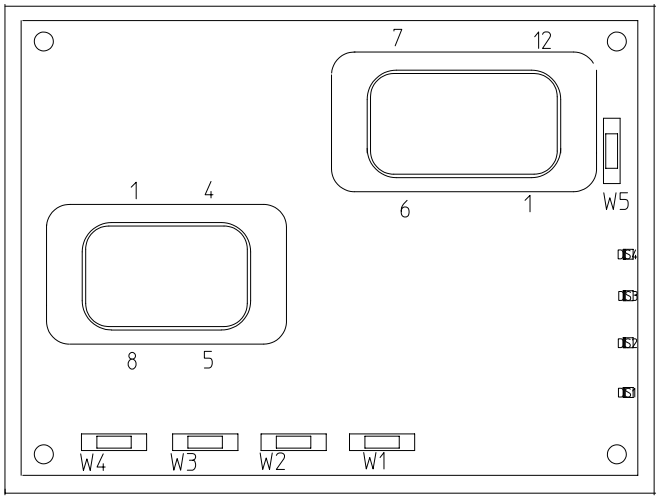


FIGURE 7-2. NETWORK INTERFACE MODULE CONFIGURATION JUMPERS

SmartCraft is a trademark of the Brunswick Corporation.

8. Adjusting AC Output Voltage

USING DIGITAL DISPLAY

Note: The GEN STATUS screen will not display AC Voltage while the genset is in voltage adjust mode. The line for displaying the voltage is filled in as shown in Figure 8-1. A separate voltmeter is required for voltage adjustment.

1. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds. Make sure all loads have been disconnected.
2. Rapidly press **START** 6 times *during the first minute after startup* to put the genset controller into *voltage adjust mode*. The green status lamp will blink rapidly and the Display will indicate a Status change from *Running* to *Volt Adj* (Figure 8-1).
3. ***To adjust voltage up***, press and quickly release **START**. Voltage will increase approximately 0.6 volts each press and release.
4. ***To adjust voltage down***, press and hold **START** for about 1 second. Voltage will decrease approximately 0.6 volts each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the Display to indicate a Status change from *Volt Adj* to *Running* and then press **STOP** to stop the genset and save the adjustment.
6. Restart the genset and check voltage.
7. Recalibrate AC Voltage on the Digital Display as instructed in the Operator's Manual.

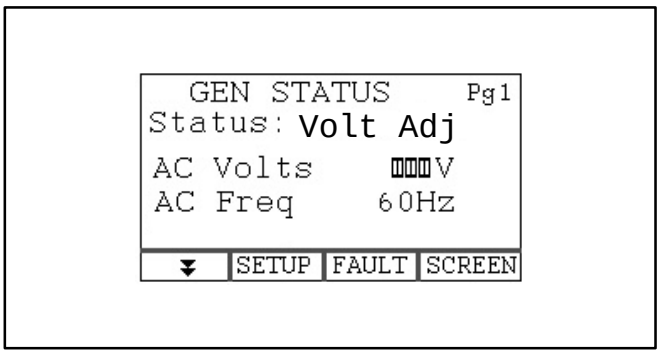


FIGURE 8-1. VOLTAGE ADJUSTMENT SCREEN

USING CONTROL SWITCH

1. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds. Make sure all loads have been disconnected.
2. Rapidly press **START** 6 times *during the first minute after startup* to put the genset controller into *voltage adjust mode*. The amber status lamp will begin blinking about once every second to indicate the change to voltage adjust mode. The green status lamp will remain on.
3. ***To adjust voltage up***, press and quickly release **START**. Voltage will increase approximately 0.6 volts each press and release.
4. ***To adjust voltage down***, press and hold **START** for about 2 second. Voltage will decrease approximately 0.6 volts each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the amber lamp to stop blinking and then press **STOP** to stop the genset and save the adjustment.
6. Restart the genset and check voltage.

9. Installation Review and Startup

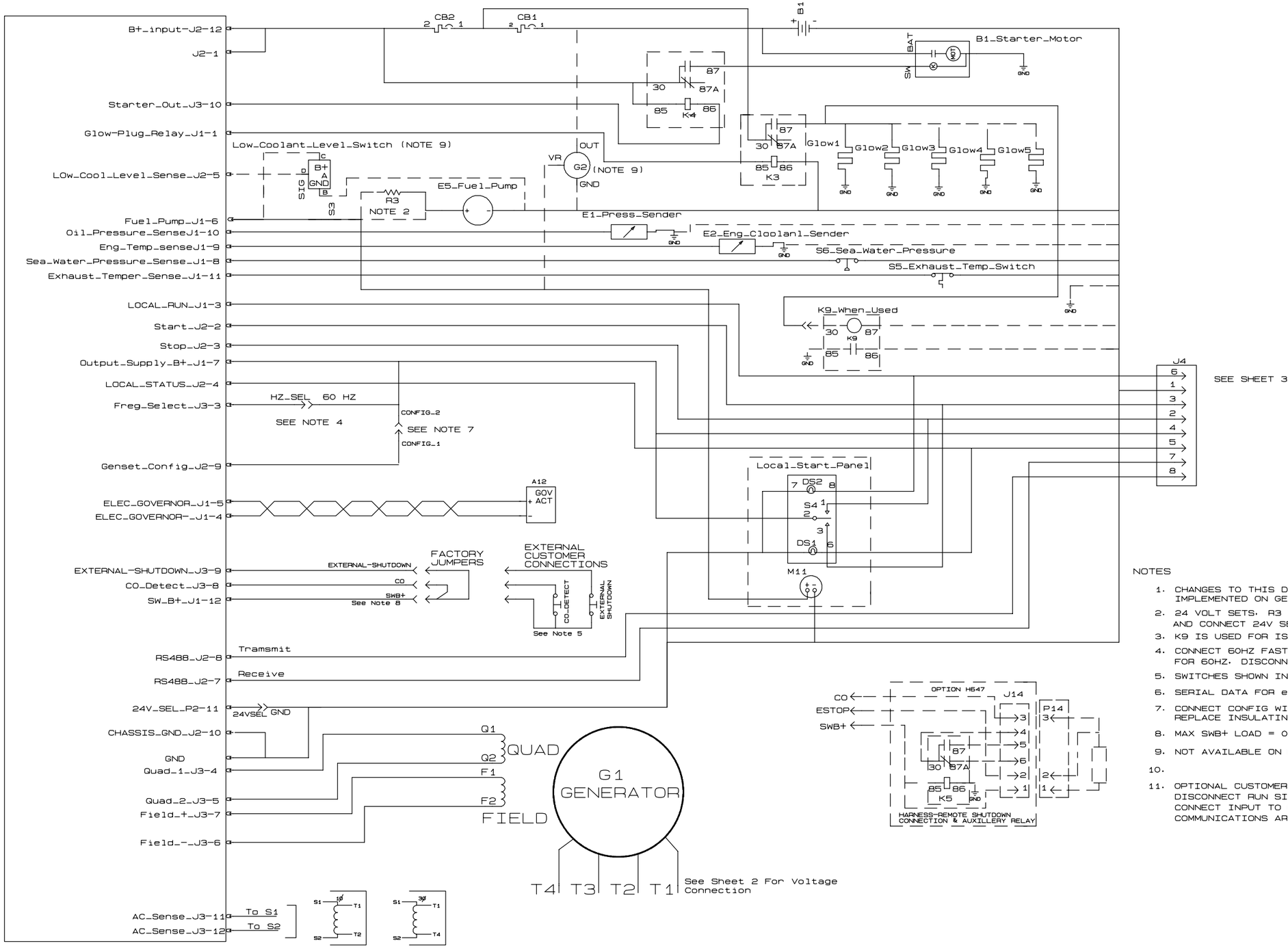
Before starting the genset, review the installation checklist below for those items that do not require the genset to be actually running. Make necessary reconnections, modifications and repairs. Then start and operate the genset in accordance with the Operator's Manual, observing all of its instructions and precautions. Continue working through the installation checklist with the genset running, making necessary reconnections, modifications and repairs. Check off (√) each item that can be answered positively. Do not place the genset in service until each item has been checked off.

- ☐ The RAW WATER PICKUP TEST was conducted during the sea trials to establish the water line and a siphon break was installed, if found necessary.
- ☐ The sea trials established that there is no backflow through the exhaust through-hull fitting or water separator drain hose when the boat is under way, forward or reverse.
- ☐ Genset compartment ventilation meets regulations and the sea trials established that ventilation is sufficient to maintain acceptable genset compartment temperatures, even while "heat soaking" after returning and docking.
- ☐ The living quarters are sealed against leaks from spaces where exhaust and fuel vapors can accumulate.
- ☐ The genset is securely mounted.
- ☐ There is adequate clearance for conducting all maintenance specified in the Operator's Manual.
- ☐ The coolant recovery tank is mounted properly and is accessible for inspection and filling.
- ☐ The entire exhaust system is accessible for inspection and replacement.
- ☐ Fuel tanks, piping, hoses and filters comply with regulations and are accessible for inspection and replacement.
- ☐ The genset is bonded to the boat grounding system in accordance with regulations.
- ☐ All grounded cranking motor circuits are connected by properly sized common bonding conductors.
- ☐ If required, the kit for isolated DC ground was installed.
- ☐ An approved transfer switch prevents interconnections between shore power and genset.
- ☐ AC wiring methods, materials and bonding for grounding meet regulations.
- ☐ A properly sized battery has been installed, serviced and charged. The battery is securely mounted in an adequately ventilated space and the positive (**+**) terminal is shielded from accidental contact.
- ☐ Remote *e*-Series Digital Displays and control switches function as intended.
- ☐ Emergency and/or CO detection and shutdown devices have been connected and have been tested to determine that the genset shuts down as intended.
- ☐ The genset is properly sized for the application, the voltage and frequency are correct and the loads across a multi-phase generator are balanced.
- ☐ Exhaust back pressure is acceptable.
- ☐ The exhaust system is leak-free and conveys all engine exhaust outside, away from windows, doors and vents.
- ☐ The fuel supply system is leak-free.
- ☐ The engine coolant and raw water systems are leak-free.
- ☐ The engine has the proper levels of oil and coolant.
- ☐ The raw water pump has been primed and the sea cock is open.
- ☐ All operators have been thoroughly briefed on the Operator's Manual and its safety precautions—especially concerning the dangers of Carbon Monoxide—and can demonstrate how to operate, maintain and troubleshoot the genset as explained therein.

10. Specifications

		MDKBK	MDKBL	MDKBM	MDKBN
ALTERNATOR: Single-Bearing, Brushless 4-Pole Rotating Field with Digital Electronic Regulation. See Genset Nameplate for Rating.					
FUEL CONSUMPTION:					
60 Hz:	Full Load Half Load	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	1.0 gph (3.8 liter/hr) 0.6 gph (2.3 liter/hr)	1.2 gph (4.5 liter/hr) 0.7 gph (2.7 liter/hr)
50 Hz:	Full Load Half Load	0.7 gph (2.7 liter/hr) 0.4 gph (1.5 liter/hr)	0.7 gph (2.7 liter/hr) 0.4 gph (1.5 liter/hr)	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	0.9 gph (3.4 liter/hr) 0.5 gph (1.9 liter/hr)
ENGINE: Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing					
Model		D1105	D1105	V1305	V1505
Number of Cylinders		3	3	4	4
Displacement		68.58 in^3 (1124 cm^3)	68.58 in^3 (1124 cm^3)	81.47 in^3 (1335 cm^3)	91.44 in^3 (1499 cm^3)
Bore		3.07 in (78 mm)	3.07 in (78 mm)	2.99 in (76 mm)	3.07 in (78 mm)
Stroke		3.09 in (78.4 mm)	3.09 in (78.4 mm)	2.90 in (73.6 mm)	3.09 in (78.4 mm)
Compression Ratio		22:1	22:1	22:1	22:1
Firing Order (Clockwise Rotation)		1-2-3	1-2-3	1-2-4-3	1-2-4-3
Fuel Injection Timing		15.5° – 17.5° BTDC	15.5° – 17.5° BTDC	15.5° – 17.5° BTDC	15.5° – 17.5° BTDC
Valve Lash (cold)		0.0071 – 0.0087 in (0.18 – 0.22 mm)	0.0071 – 0.0087 in (0.18 – 0.22 mm)	0.0071 – 0.0087 in (0.18 – 0.22 mm)	0.0071 – 0.0087 in (0.18 – 0.22 mm)
Lube Oil Capacity		4.2 quart (4.0 liter)	4.2 quart (4.0 liter)	4.5 quart (4.3 liter)	4.5 quart (4.3 liter)
Lube Oil Drain Connection		3/8 NPT	3/8 NPT	3/8 NPT	3/8 NPT
Coolant Capacity		4.2 quart (4.0 liter)	4.2 quart (4.0 liter)	5.3 quart (5.0 liter)	5.3 quart (5.0 liter)
Coolant Flow Rate:	60 Hz 50 Hz	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)	5.0 gpm (18.9liter/min) 4.2 gpm (15.9 liter/min)
Raw Water Flow Rate:	60 Hz 50 Hz	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)
Combustion Air Flow:	60 Hz 50 Hz	30 cfm (0.85 m^3/min) 25 cfm (0.71 m^3/min)	30 cfm (0.85 m^3/min) 25 cfm (0.71 m^3/min)	36 cfm (1.02 m^3/min) 30 cfm (0.85 m^3/min))	41 cfm (1.16 m^3/min) 34 cfm (0.96 m^3/min)
Heat Rejection to Ambient:	60 Hz 50 Hz	200 Btu/min (50 kcal/min) 179 Btu/min (45 kcal/min)	200 Btu/min (50 kcal/min) 179 Btu/min (45 kcal/min)	230 Btu/min (58 kcal/min) 190 Btu/min (48 kcal/min)	280 Btu/min (71 kcal/min) 210 Btu/min (53 kcal/min)
CONNECTIONS:					
Max Fuel Pump Lift		4 ft (1.2 m)	4 ft (1.2 m)	4 ft (1.2 m)	4 ft (1.2 m)
Fuel Supply		1/4 NPT female	1/4 NPT female	1/4 NPT female	1/4 NPT female
Fuel Return		1/4 NPT female	1/4 NPT female	1/4 NPT female	1/4 NPT female
Max Raw Water Pump Lift		4 ft (1.22 m)	4 ft (1.22 m)	4 ft (1.22 m)	4 ft (1.22 m)
Raw Water Inlet		1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Wet Exhaust Outlet		2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose
Dry Exhaust Outlet		1-1/4 NPT	1-1/4 NPT	1-1/4 NPT	1-1/4 NPT
Max Exhaust Back Pressure		3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg
KEEL COOLING:					
Coolant Inlet & Outlet		1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Max Coolant Friction Head		1 psi (6.9 kPa)	1 psi (6.9 kPa)	1 psi (6.9 kPa)	1 psi (6.9 kPa)
Heat Rejection to Coolant:	60 Hz 50 Hz	950 Btu/min (239 kcal/min) 780 Btu/min (197 kcal/min)	950 Btu/min (239 kcal/min) 780 Btu/min (197 kcal/min)	1220 Btu/min (307 kcal/min) 980 Btu/min (247 kcal/min)	1420 Btu/min (358 kcal/min) 1160 Btu/min (292 kcal/min)
Thermostat Opening Temperature		185° F (85° C)	185° F (85° C)	185° F (85° C)	185° F (85° C)
BATTERIES:					
Nominal Battery Voltage		12 volts*	12 volts*	12 volts*	12 volts*
Min CCA Rating – SAE @ 32° F (0° C)		360 amps	360 amps	500 amps	500 amps
Battery Charging @ 12/24 VDC		5/10 amps	5/10 amps	5/10 amps	5/10 amps
SIZE, WEIGHT, NOISE:					
Without Enclosure Dry Weight Dimensions: L x W x H		525 lbs (238 kg) 32.4 x 18.9 x 22.1 in (479.1 x 822.6 x 560.9 mm)	555 lbs (252 kg) 35.9 x 22.3 x 23.0 in (911 x 566 x 585 mm)	640 lbs (290 kg) 40.7 x 22.3 x 23.0 in (1033 x 566 x 585 mm)	640 lbs (290 kg) 40.7 x 22.3 x 23.0 in (1033 x 566 x 585 mm)
With Enclosure Noise Dry Weight Dimensions: L x W x H		–	66/65 dB(A) @ 60/50HZ 600 lbs (272 kg) 35.9 x 22.3 x 23.4 in (911 x 566 x 593 mm)	66/65 dB(A) @ 60/50HZ 695 lbs (315 kg) 40.7 x 22.3 x 23.4 in (1033 x 566 x 593 mm)	66/65 dB(A) @ 60/50HZ 695 lbs (315 kg) 40.7 x 22.3 x 23.4 in (1033 x 566 x 593 mm)
* - 24 volts optional					

	MDKBP	MDKBR	MDKBS
ALTERNATOR: Single-Bearing, Brushless 4-Pole Rotating Field with Digital Electronic Regulation. See Genset Nameplate for Rating.			
FUEL CONSUMPTION:			
60 Hz: Full Load Half Load	1.3 gph (4.9 liter/hr) 0.8 gph (3.0 liter/hr)	1.9 gph (7.2 liter/hr) 1.1 gph (4.2 liter/hr)	2.5 gph (9.5 liter/hr) 1.5 gph (5.7 liter/hr)
50 Hz: Full Load Half Load	1.1 gph (4.2 liter/hr) 0.7 gph (2.7 liter/hr)	1.6 gph (6.1 liter/hr) 0.9 gph (3.4 liter/hr)	2.1 gph (8.0 liter/hr) 1.3 gph (4.9 liter/hr)
ENGINE: Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing			
Model	V1903B	V2203B	V2803B
Number of Cylinders	4	4	5
Displacement	113.37 in^3 (1857 cm^3)	134.07 in^3 (2197cm^3)	167.57 in^3 (2748 cm^3)
Bore	3.15 in (80 mm)	3.43 in (87 mm)	3.43 in (87 mm)
Stroke	3.64 in (92.4 mm)	3.64 in (92.4 mm)	3.64 in (92.4 mm)
Compression Ratio	23:1	23:1	23:1
Firing Order (Clockwise Rotation)	1-3-4-2	1-3-4-2	1-3-5-4-2
Fuel Injection Timing	15.5° – 17.5° BTDC	15.5° – 17.5° BTDC	15.5° – 17.5° BTDC
Valve Lash (cold)	0.0071 – 0.0087 in (0.18 – 0.22 mm)	0.0071 – 0.0087 in (0.18 – 0.22 mm)	0.0071 – 0.0087 in (0.18 – 0.22 mm)
Lube Oil Capacity	8 quart (7.6 liter)	8 quart (7.6 liter)	12.7 quart (12 liter)
Lube Oil Drain Connection	3/8 NPT	3/8 NPT	3/8 NPT
Coolant Capacity	8 quart (7.6 liter)	8 quart (7.6 liter)	8 quart (7.6 liter)
Coolant Flow Rate: 60 Hz 50 Hz	14.0 gpm (53.0 liter/min) 10.0 gpm (37.9 liter/min)	14.0 gpm (53.0 liter/min) 10.0 gpm (37.9 liter/min))	14.0 gpm (53.0 liter/min) 10.0 gpm (37.9 liter/min)
Raw Water Flow Rate: 60 Hz 50 Hz	9.0 gpm (34.1 liter/min) 7.0 gpm (26.5 liter/min)	9.0 gpm (34.1 liter/min) 7.0 gpm (26.5 liter/min)	9.0 gpm (34.1 liter/min) 7.0 gpm (26.5 liter/min)
Combustion Air Flow: 60 Hz 50 Hz	52 cfm (1.45 m^3/min) 42 cfm (1.21 m^3/min)	60 cfm (1.72 m^3/min) 50 cfm (1.43 m^3/min))	75 cfm (2.12 m^3/min) 63 cfm (1.78 m^3/min)
Heat Rejection to Ambient: 60 Hz 50 Hz	350 Btu/min (88 kcal/min) 285 Btu/min (72 kcal/min)	420 Btu/min (106 kcal/min) 350 Btu/min (88 kcal/min)	530 Btu/min (134 kcal/min) 450 Btu/min (114 kcal/min)
CONNECTIONS:			
Max Fuel Pump Lift	4 ft (1.2 m)	4 ft (1.2 m)	4 ft (1.2 m)
Fuel Supply	1/4 NPT female	1/4 NPT female	1/4 NPT female
Fuel Return	1/4 NPT female	1/4 NPT female	1/4 NPT female
Max Raw Water Pump Lift	4 ft (1.22 m)	4 ft (1.22 m)	4 ft (1.22 m)
Raw Water Inlet	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Wet Exhaust Outlet	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose
Dry Exhaust Outlet	1-1/2 NPT	1-1/2 NPT	1-1/2 NPT
Max Exhaust Back Pressure	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg
KEEL COOLING:			
Coolant Inlet & Outlet	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Max Coolant Friction Head	1 psi (6.9 kPa)	1 psi (6.9 kPa)	1 psi (6.9 kPa)
Heat Rejection to Coolant: 60 Hz 50 Hz	1590 Btu/min (402 kcal/min) 1500 Btu/min (379 kcal/min)	1980 Btu/min (500 kcal/min) 1670 Btu/min (422 kcal/min)	2490 Btu/min (629 kcal/min) 2090 Btu/min (528 kcal/min)
Thermostat Opening Temperature	185° F (85° C)	185° F (85° C)	185° F (85° C)
BATTERIES:			
Nominal Battery Voltage	12 volts*	12 volts*	12 volts*
Min CCA Rating – SAE @ 32° F (0° C)	500 amps	625 amps	625 amps
Battery Charging @ 12/24 VDC	40/20 amps	40/20 amps	40/20 amps
SIZE, WEIGHT, NOISE:			
Without Enclosure Dry Weight Dimensions: L x W x H	 830 lbs (377 kg) 44.4 x 23.7 x 26.1 in (1127 x 602 x 663 mm)	 870 lbs (375 kg) 44.4 x 23.7 x 26.1 in (1127 x 602 x 663 mm)	 1090 lbs (494 kg) 53.5 x 23.7 x 28.8 in (1358 x 602 x 732 mm)
With Enclosure Noise Dry Weight Dimensions: L x W x H	 67/64 dB(A) @ 60/50 HZ 890 lbs (404 kg) 44.4 x 23.7 x 27.5 in (1127 x 602 x 698 mm)	 67/64 dB(A) @ 60/50 HZ 930 lbs (422 kg) 44.4 x 23.7 x 27.5 in (1127 x 602 x 698 mm)	 68/67 dB(A) @ 60/50 HZ 1175 lbs (533 kg) 53.5 x 23.7 x 30.0 in (1358 x 602 x 763 mm)
* - 24 volts optional			



NOTES

1. CHANGES TO THIS DRAWING MUST BE IMPLEMENTED ON GENSET LABEL DRAWING
2. 24 VOLT SETS. R3 IS NEEDED AT E5 AND CONNECT 24V SEL TO GND FASTON.
3. K9 IS USED FOR ISOLATED GROUND
4. CONNECT 60HZ FASTON TO HZSEL FOR 60HZ. DISCONNECT FOR 50HZ.
5. SWITCHES SHOWN IN NORMAL RUNNING POSITION.
6. SERIAL DATA FOR e-SERIES DIGITAL DISPLAY.
7. CONNECT CONFIG WIRES TO RECONFIGURE THE CONTROL. REPLACE INSULATING CONNECTOR WHEN DONE.
8. MAX SWB+ LOAD = 0.5A.
9. NOT AVAILABLE ON MDKAU.
10.
11. OPTIONAL CUSTOMER WAKE-UP INPUT. IF USED, DISCONNECT RUN SIGNAL (P10-6) & INSULATE. CONNECT INPUT TO OPEN P10-6. COMMUNICATIONS ARE ACTIVE WHILE INPUT = B+.

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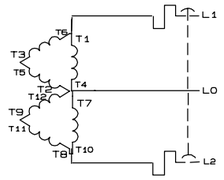
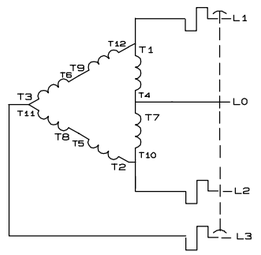
WIRING DIAGRAM (SHEET 1)



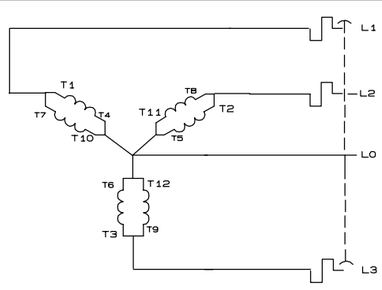
1 Ø
50 HZ
110/220V
115/230V
120/240V

1 Ø
60 HZ
120/240V



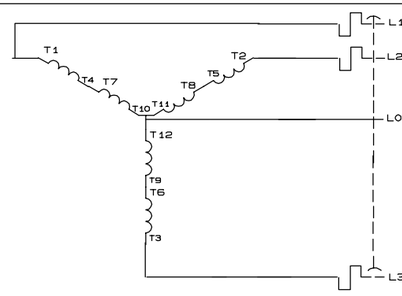
3 Ø
50 HZ
110/220V
115/230V
120/240V

3 Ø
60 HZ
120/240V



3 Ø
50 HZ
110/190V
115/200V
120/208V
127/220V

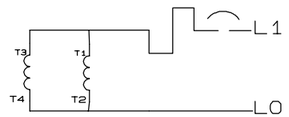
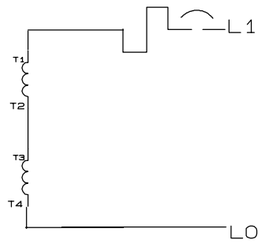
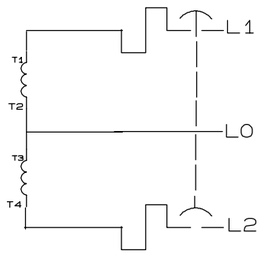
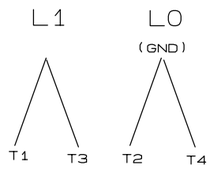
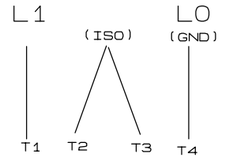
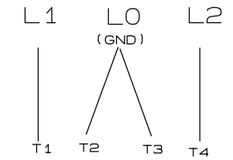
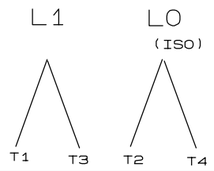
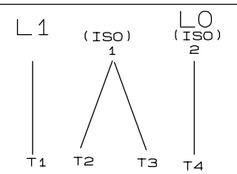
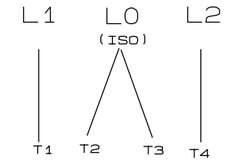
3 Ø
60 HZ
120/208V
127/220V
139/240V



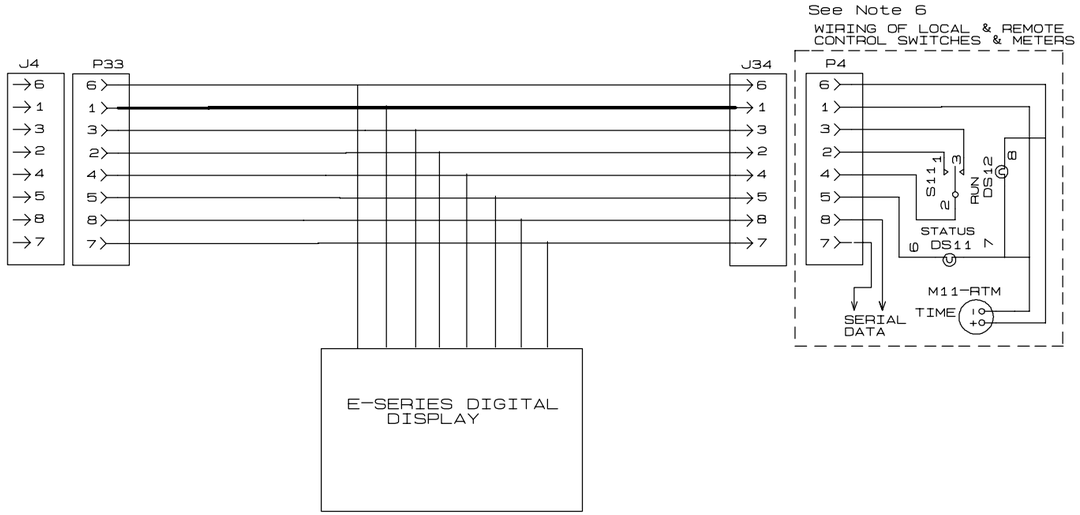
3 Ø
50 HZ
220/380V
230/400V
240/416V
254/440V

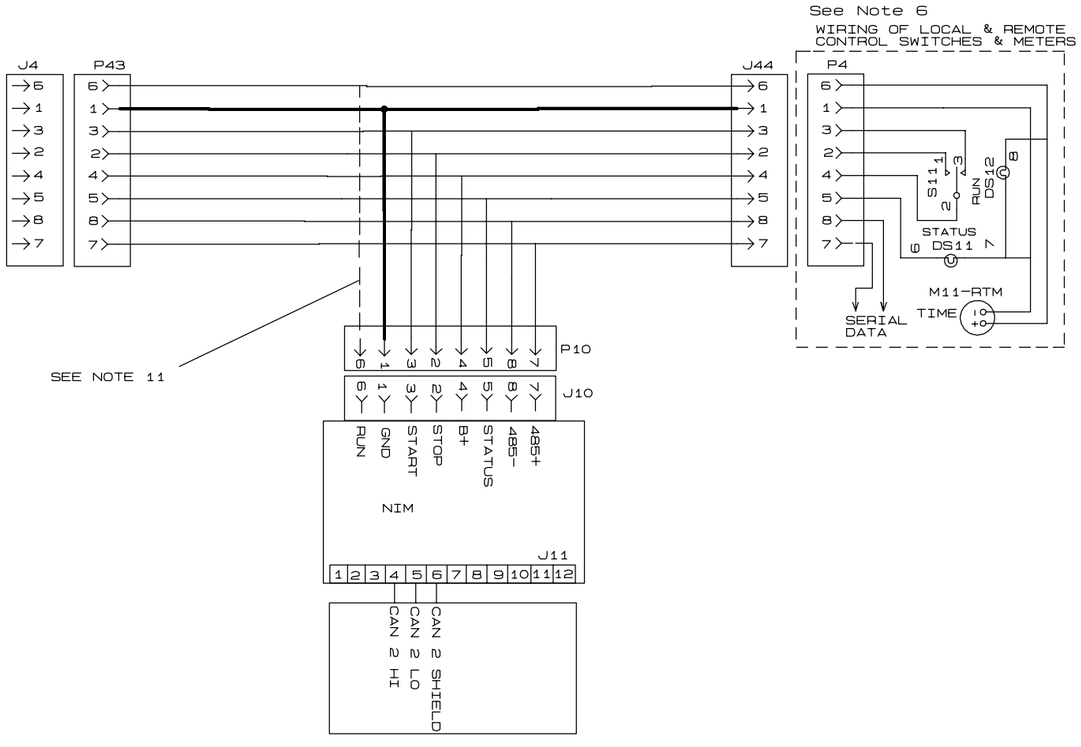
3 Ø
50 HZ
240/416V
254/440V
277/480V

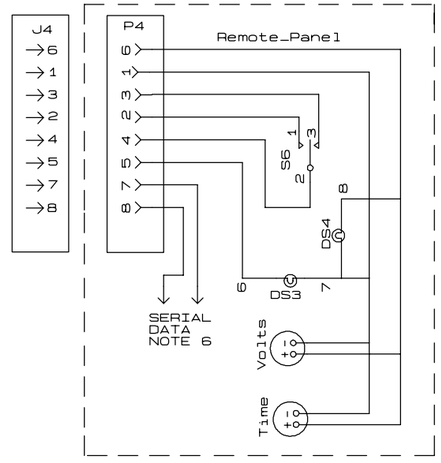
3 Ø Generator Reconnection

	A	B	C	HZ
VOLTAGE	120	240	120/240	60
	110 115 120	220 230 240	110/220 115/230 120/240	50
SCHEMATIC				
DIAGRAM GROUNDED NEUTRAL				
DIAGRAM ISOLADTED NEUTRAL				

1 Ø Generator Reconnection







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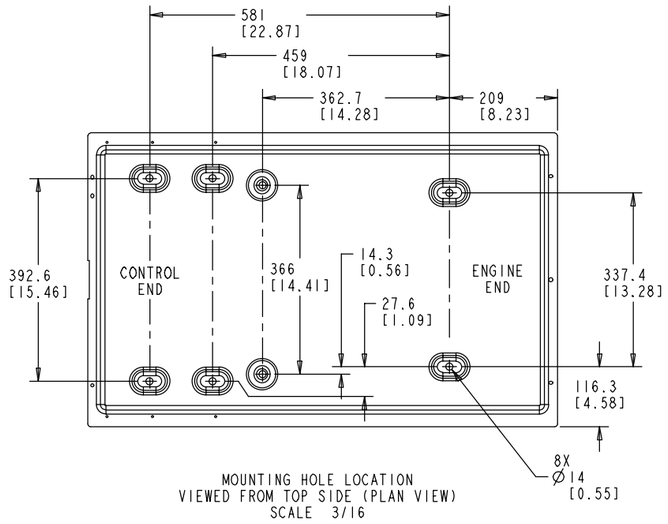
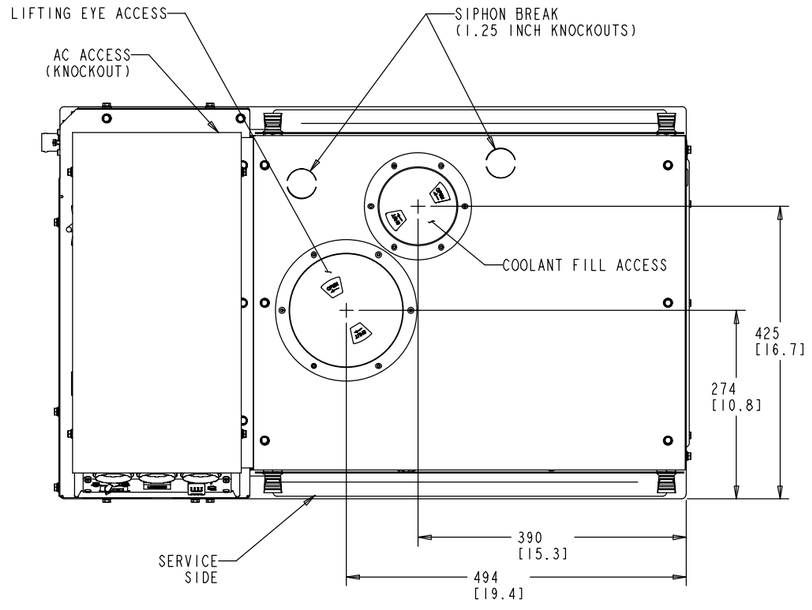
WIRING DIAGRAM (SHEET 3)



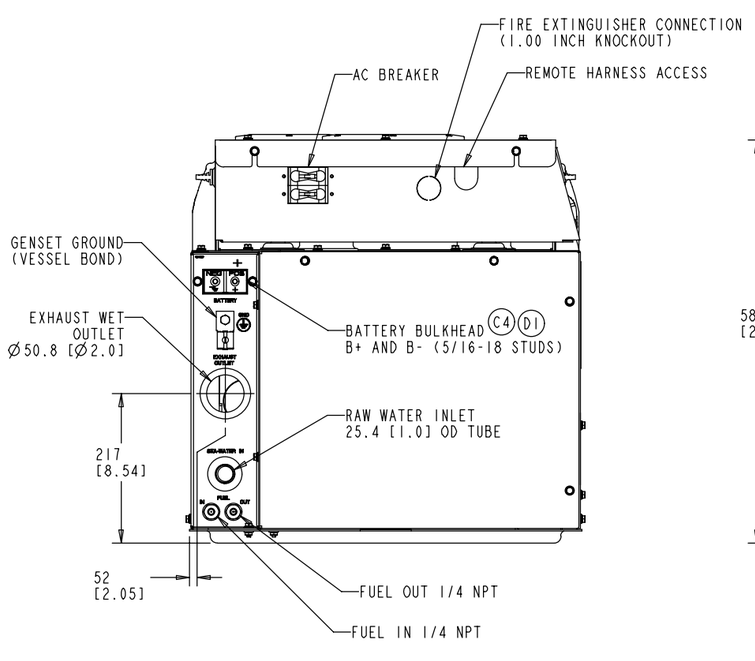
MOUNTING HOLE LOCATION
VIEWED FROM TOP SIDE (PLAN VIEW)
SCALE 3/16

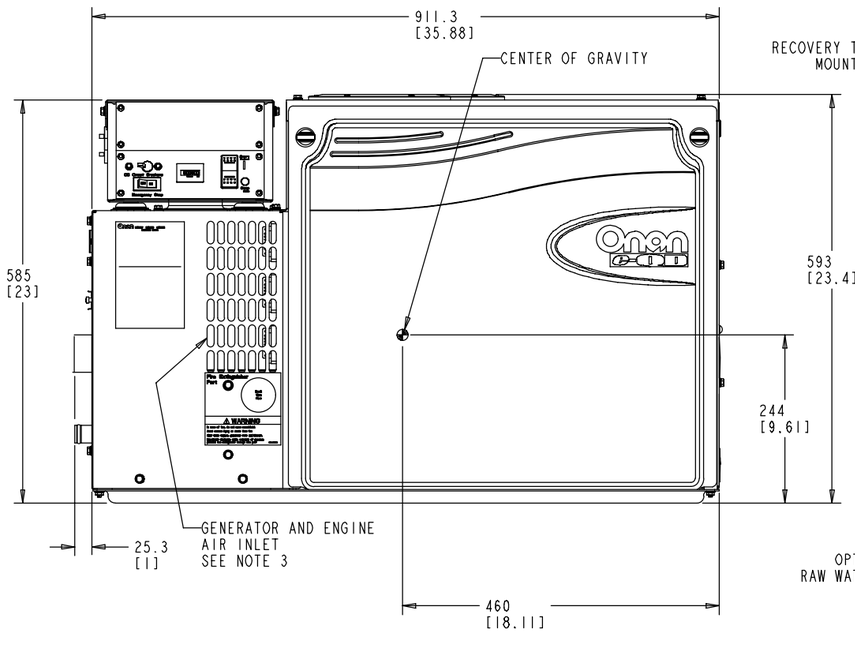


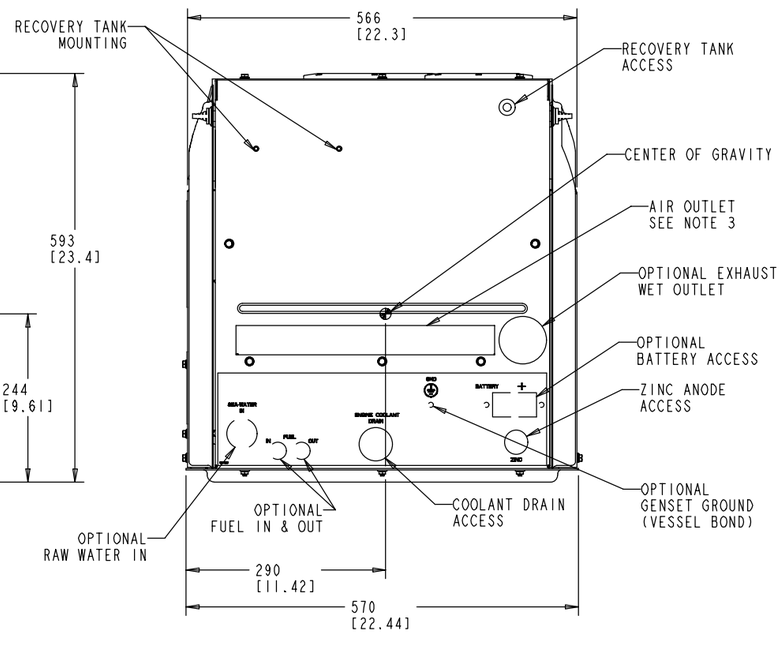
NOTES:

1. DIMENSIONS IN [ ] ARE INCHES.
2. THRU HOLES FOR HOSE ROUTING INCLUDE RUBBER GROMMETS FOR ABRAISION PROTECTION.
3. 100 [4.0] MIN CLEARANCE REQUIRED FOR AIR FLOW AT INLET AND 50 [2.0] AT OUTLET.

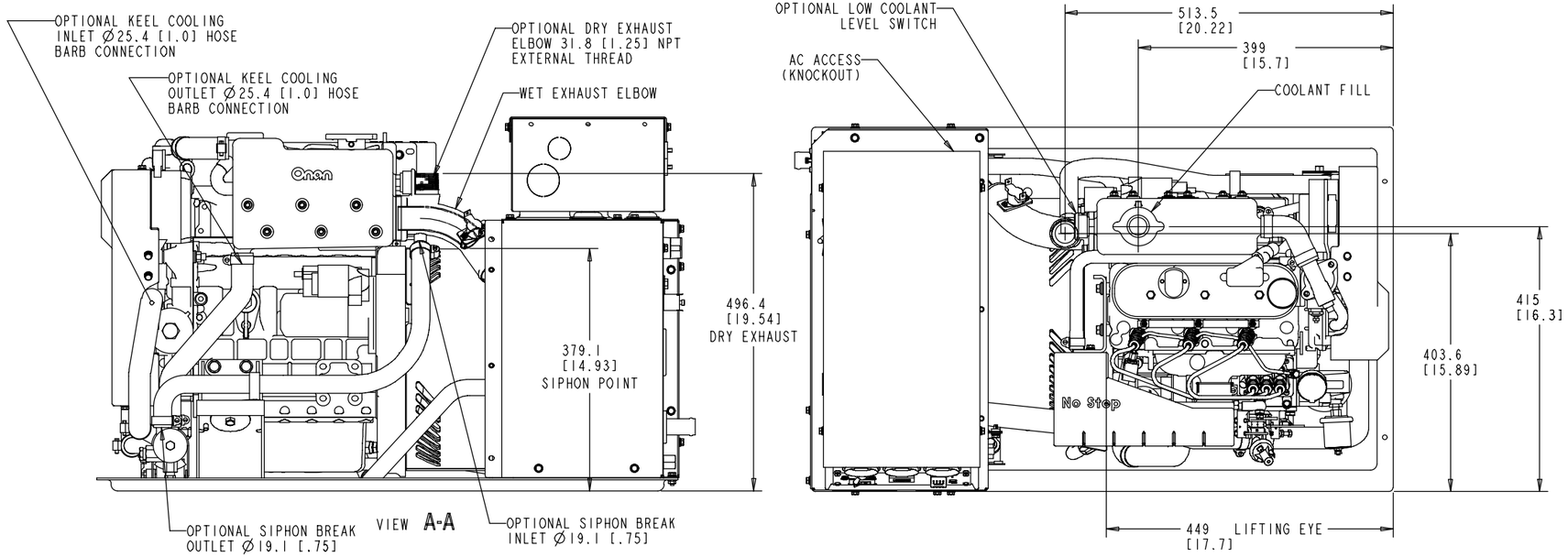
TABULATION		
MODEL	WET WEIGHT	DRY WEIGHT
HOUSED	279KG 615LB	272KG 600LB
UNHOUSED	259KG 570LB	252KG 555LB

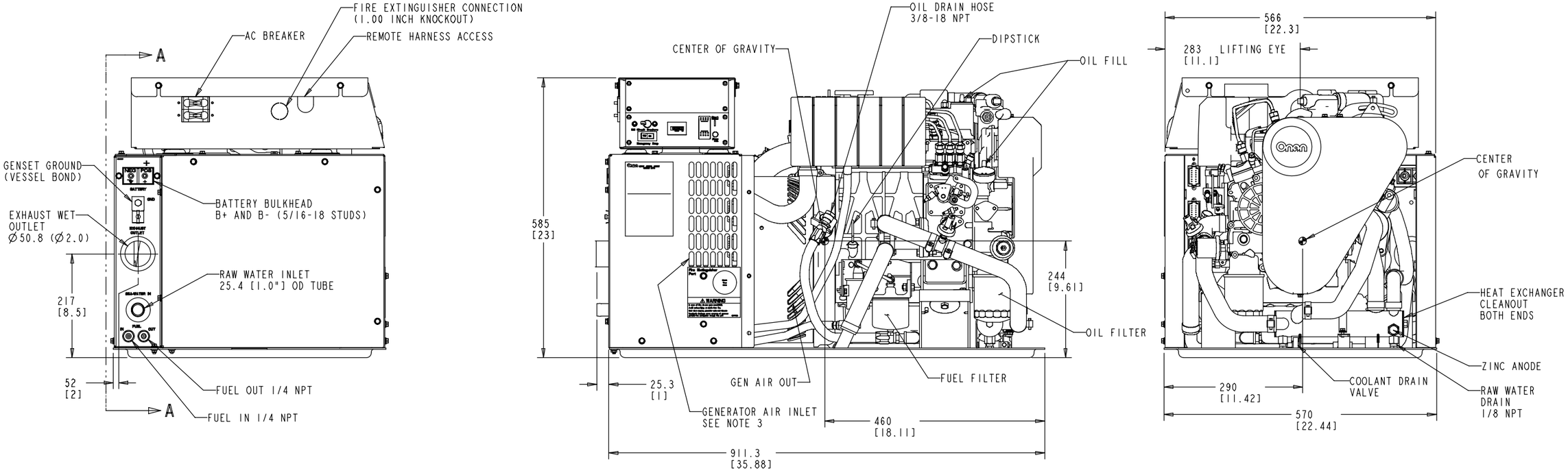




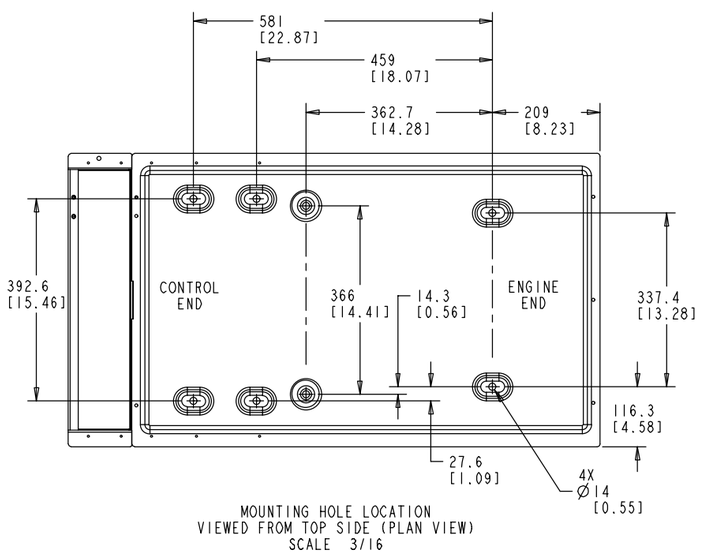


OUTLINE DRAWING—MDKBL (SHEET 1)

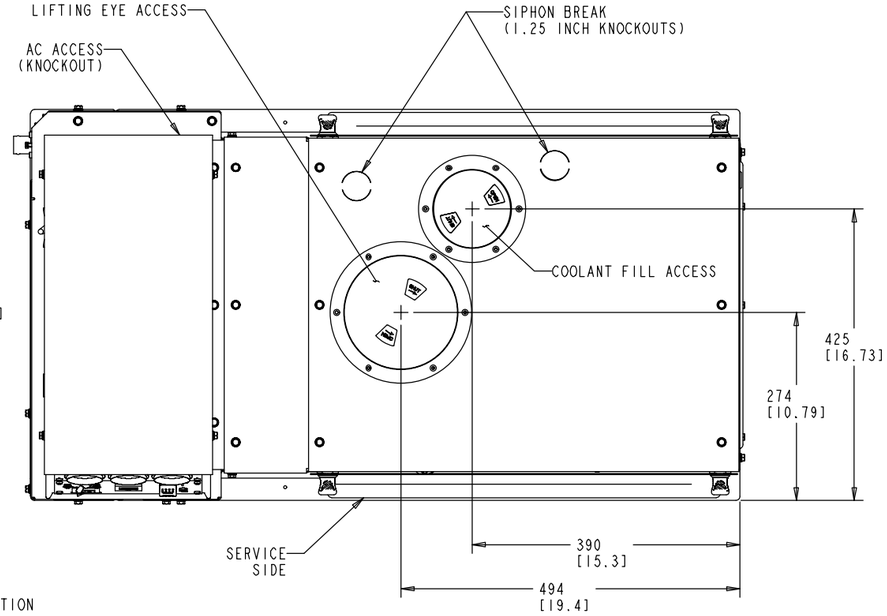

OPTIONAL KEEL COOLING INLET Ø25.4 [1.0] HOSE BARB CONNECTION
OPTIONAL KEEL COOLING OUTLET Ø25.4 [1.0] HOSE BARB CONNECTION
OPTIONAL DRY EXHAUST ELBOW 31.8 [1.25] NPT EXTERNAL THREAD
WET EXHAUST ELBOW
496.4 [19.54] DRY EXHAUST
379.1 [14.93] SIPHON POINT
OPTIONAL SIPHON BREAK OUTLET Ø19.1 [.75]
VIEW A-A
OPTIONAL SIPHON BREAK INLET Ø19.1 [.75]
OPTIONAL LOW COOLANT LEVEL SWITCH
AC ACCESS (KNOCKOUT)
513.5 [20.22]
399 [15.7]
COOLANT FILL
415 [16.3]
403.6 [15.89]
No Step
449 LIFTING EYE [17.7]



OUTLINE DRAWING—MDKBL (SHEET 2)



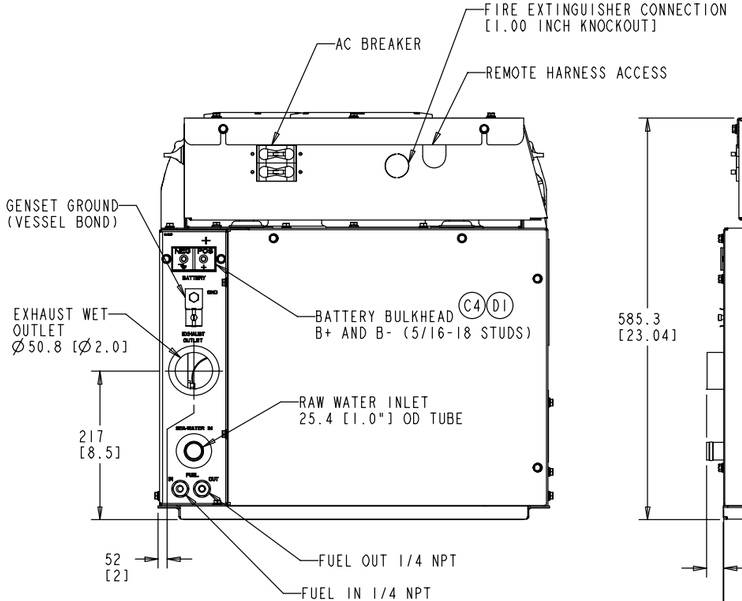
MOUNTING HOLE LOCATION
VIEWED FROM TOP SIDE (PLAN VIEW)
SCALE 3/16

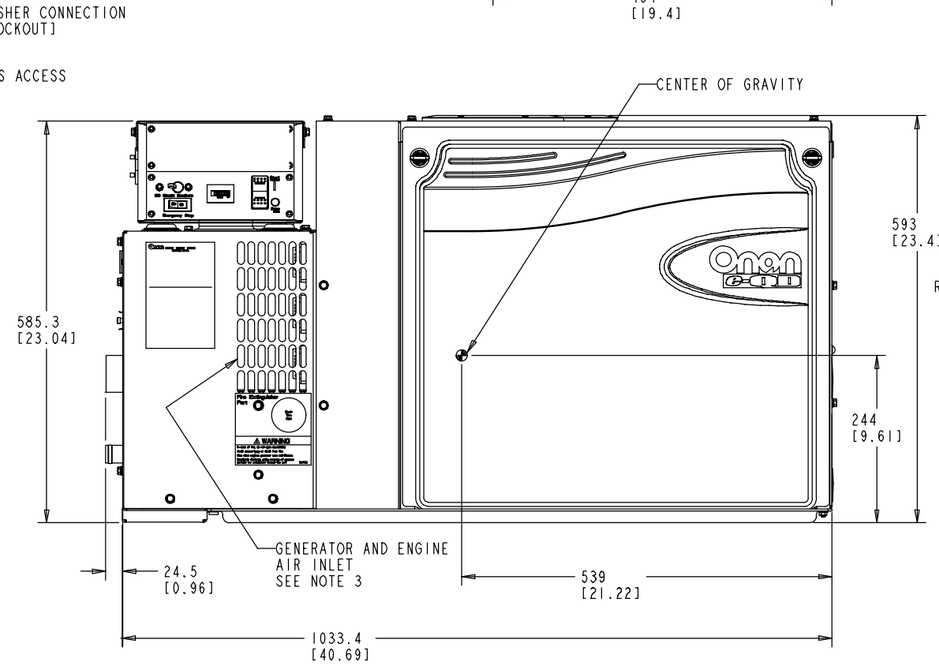


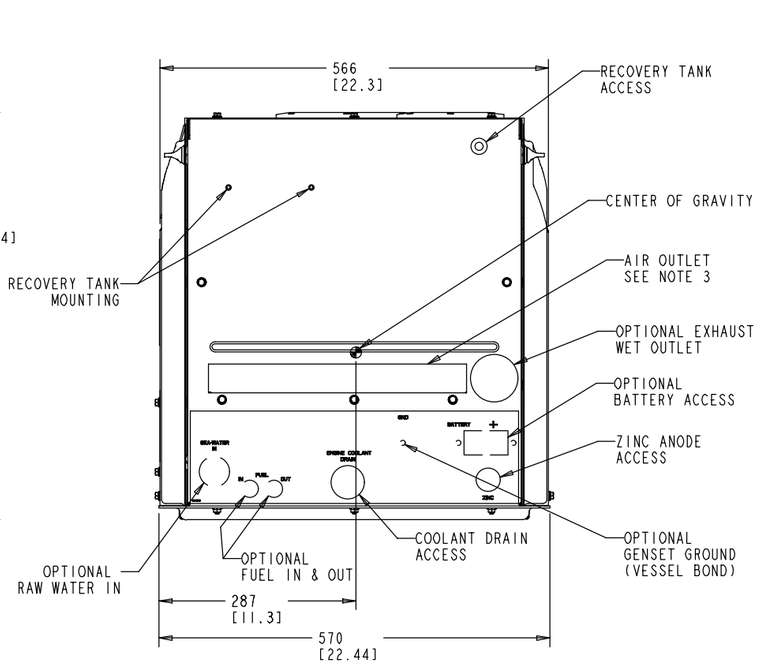
NOTES:

1. DIMENSIONS IN [ ] ARE INCHES.
2. THRU HOLES FOR HOSE ROUTING INCLUDE RUBBER GROMMETS FOR ABRAISION PROTECTION.
3. 100 [4.0] MIN CLEARANCE REQUIRED FOR AIR FLOW AT INLET AND 50 [2.0] AT OUTLET.

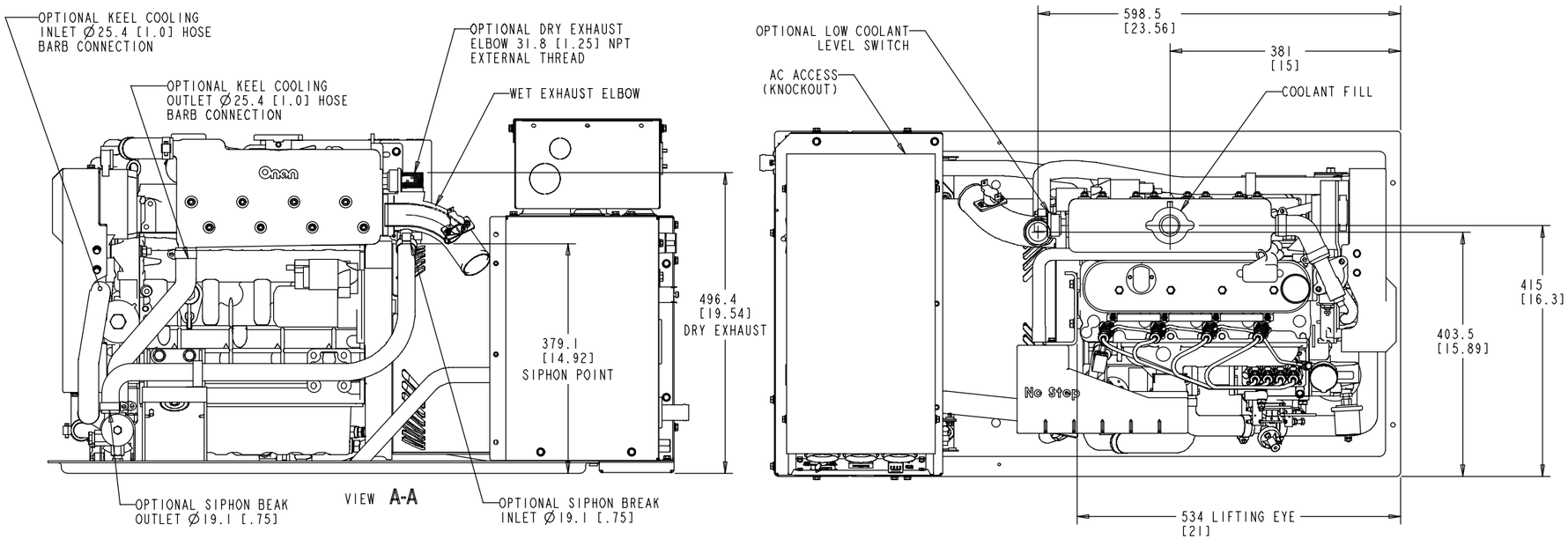
TABULATION		
MODEL	WET WEIGHT	DRY WEIGHT
HOUSED	324KG 715LB	315KG 695LB
UNHOUSED	299KG 660LB	290KG 640LB

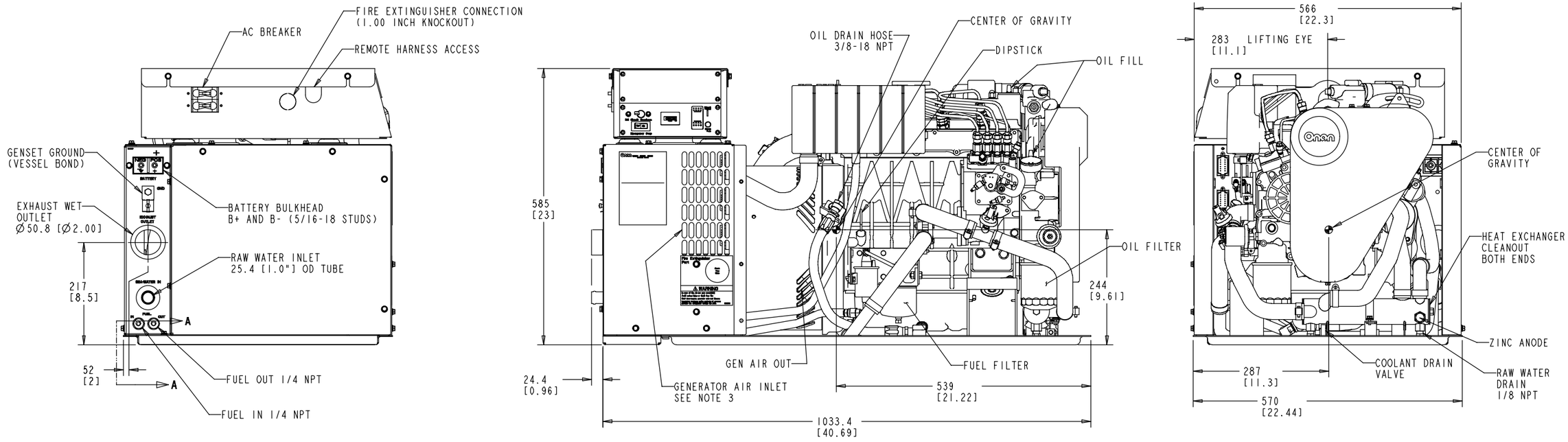




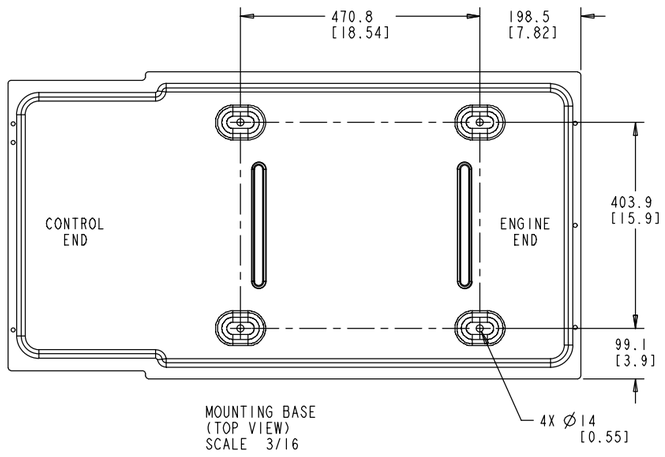


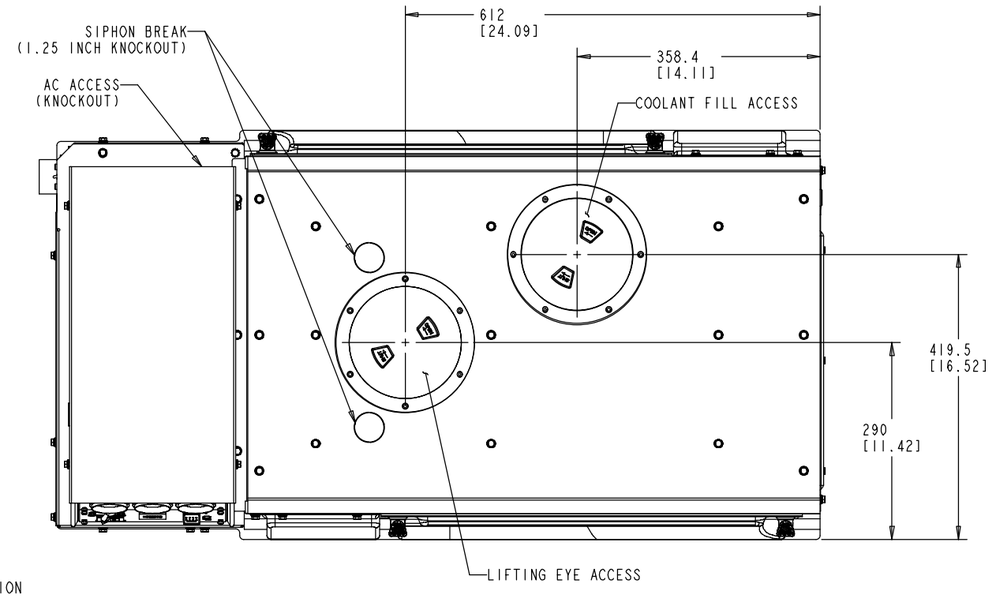
OUTLINE DRAWING—MDKBM, MDKBN (SHEET 1)





OUTLINE DRAWING—MDKBM, MDKBN (SHEET 2)

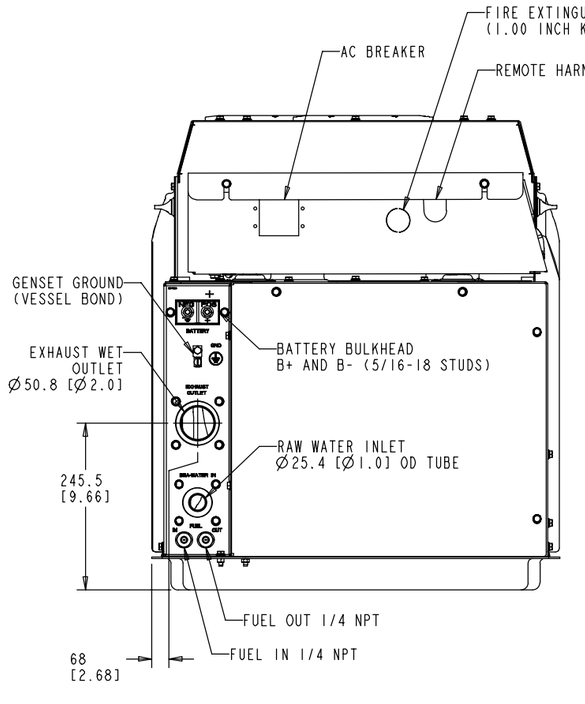


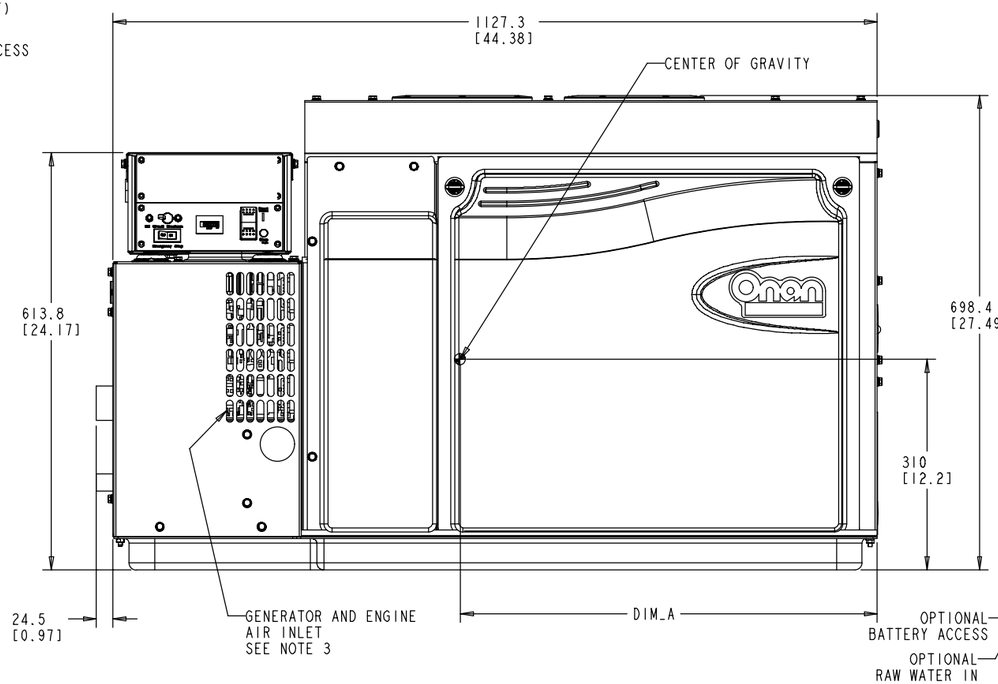


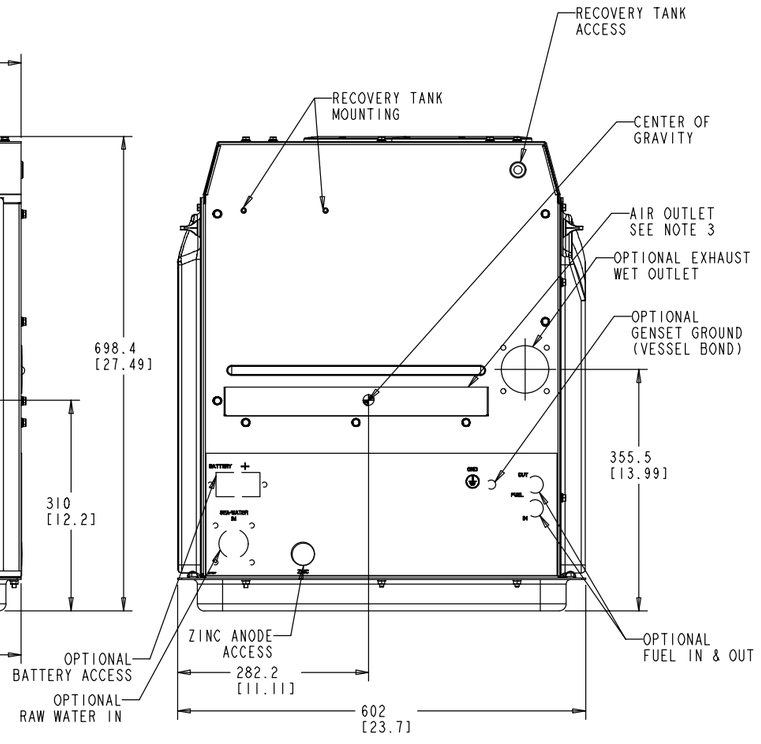
NOTES:

1. DIMENSIONS IN [ ] ARE INCHES.
2. THRU HOLES FOR HOSE ROUTING INCLUDE RUBBER GROMMETS FOR ABRAISION PROTECTION.
3. 100 [4.0] MIN CLEARANCE REQUIRED FOR AIR FLOW AT INLET AND 50 [2.0] AT OUTLET.

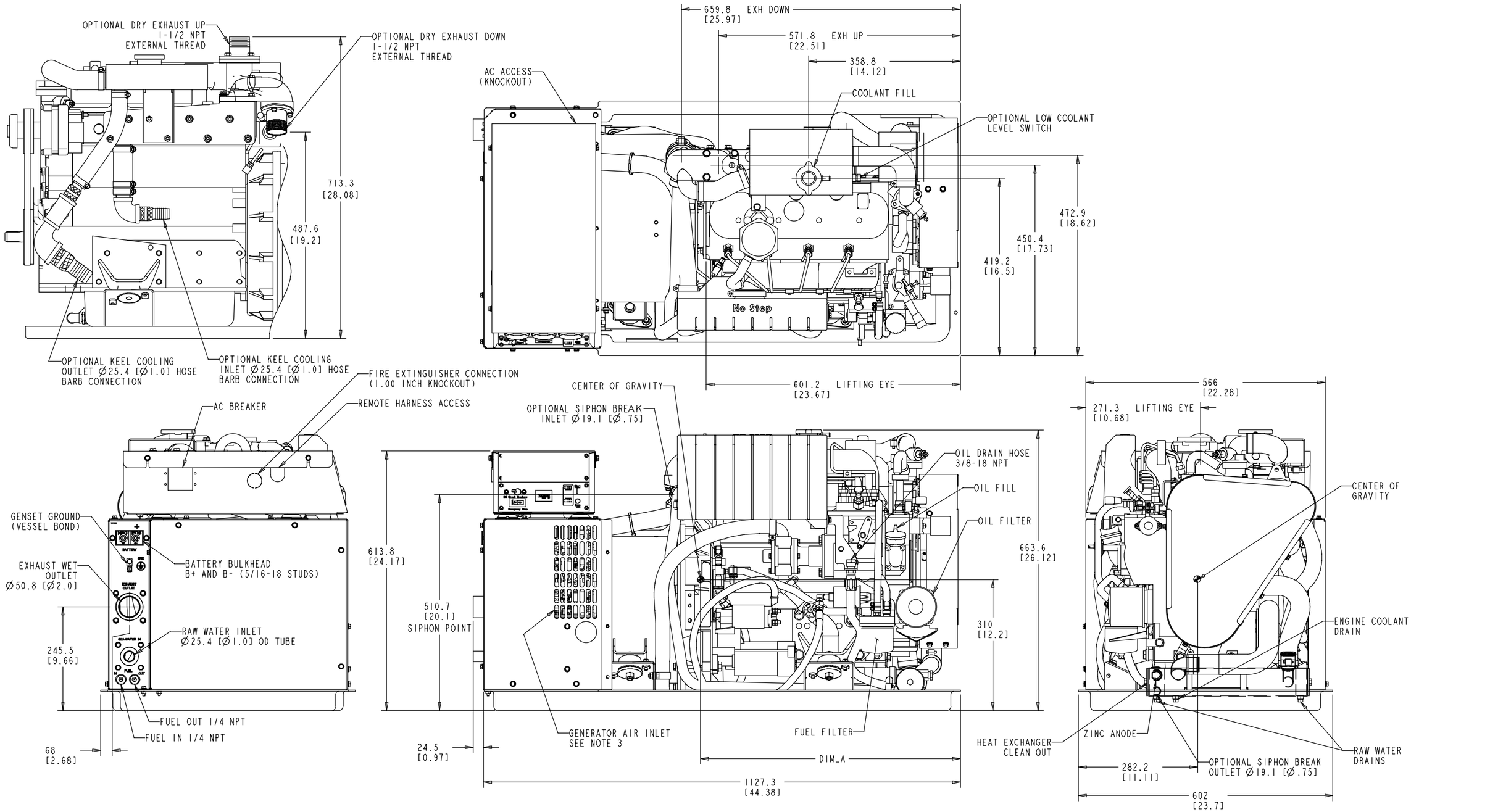
TABULATION				
MODEL	OPTION	DIM_A	WET WEIGHT	DRY WEIGHT
MDKBP	HOUSED	584.2 [23]	424KG 935LB	411KG 905LB
MDKBP	UNHOUSED	584.2 [23]	365KG 805LB	352KG 775LB
MDKBR	HOUSED	614.6 [24.2]	447KG 985LB	433KG 955LB
MDKBR	UNHOUSED	614.6 [24.2]	388KG 855LB	374KG 825LB







OUTLINE DRAWING—MDKBP, MDKBR (SHEET 1)



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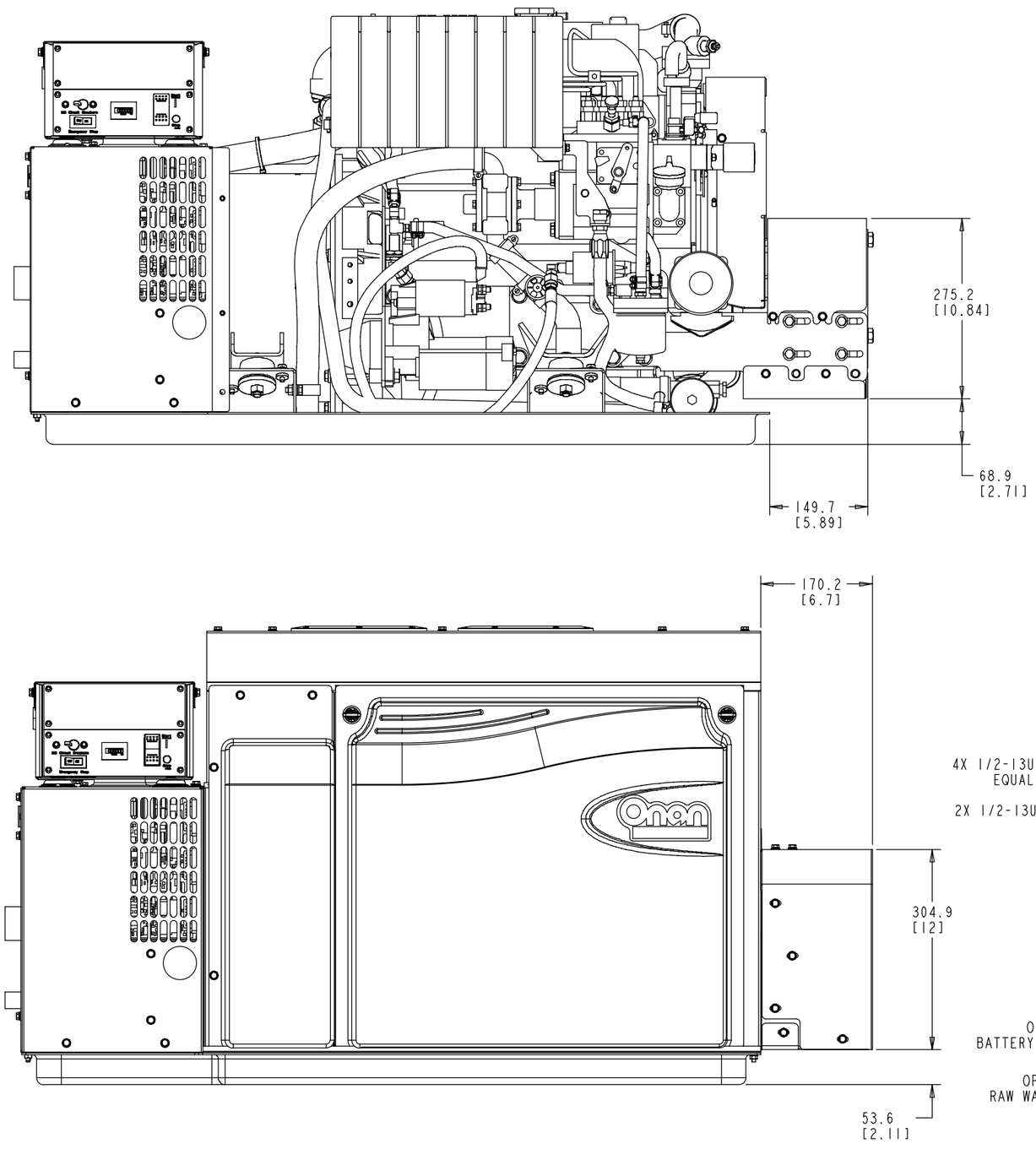
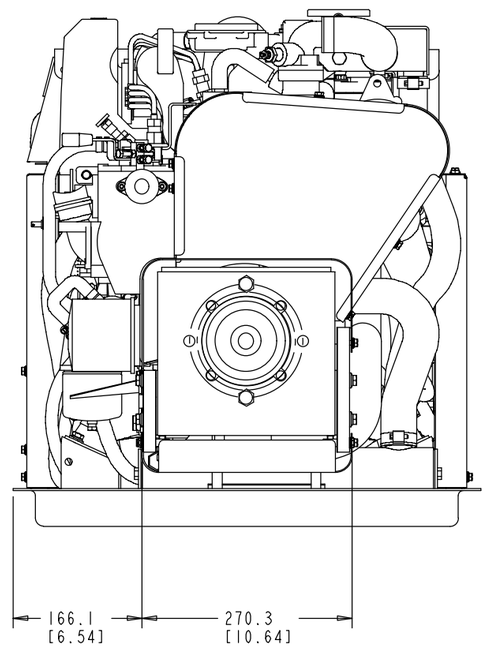
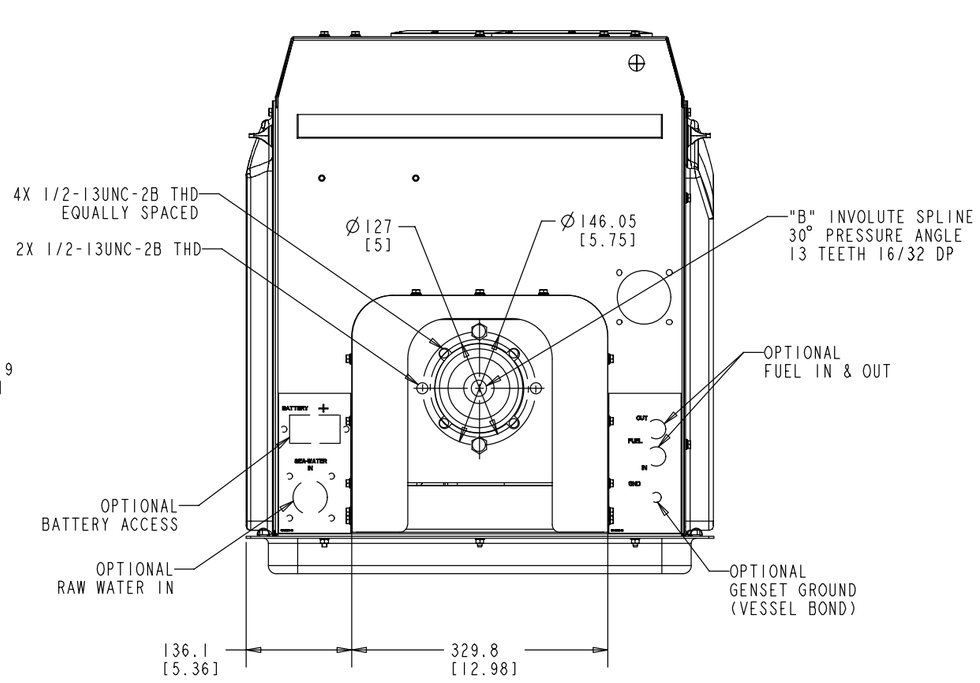
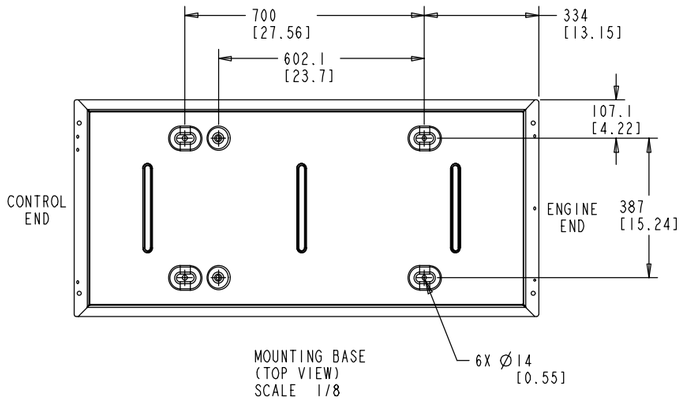
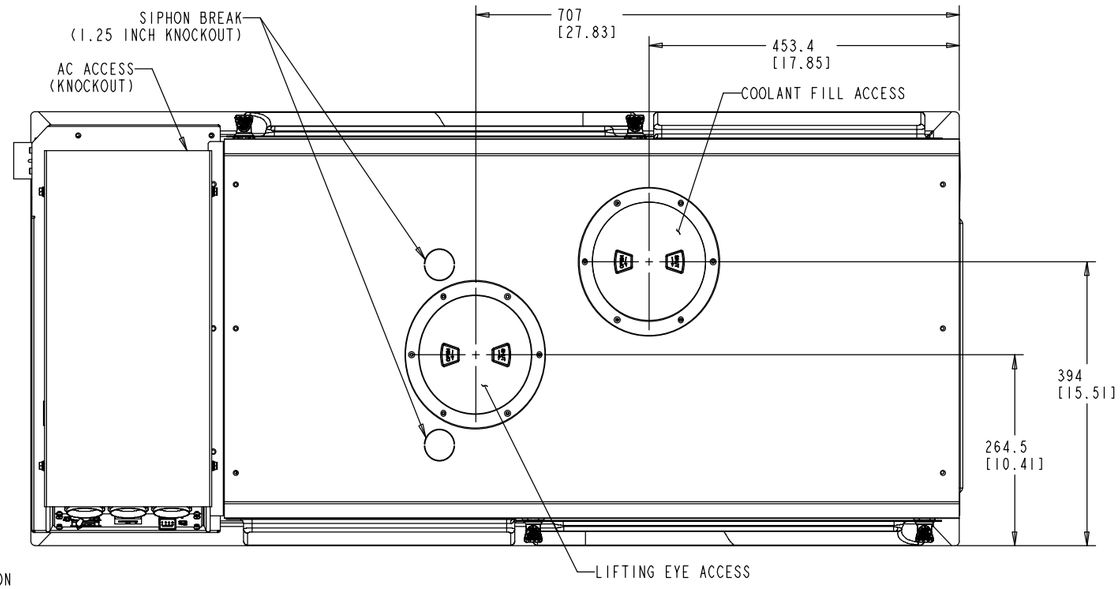






OUTLINE DRAWING—MDKBP, MDKBR (SHEET 3)

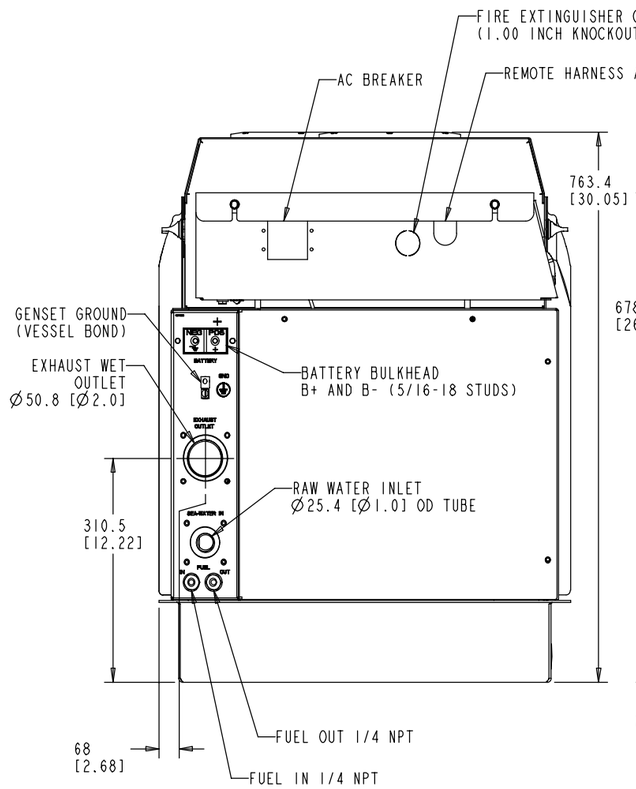


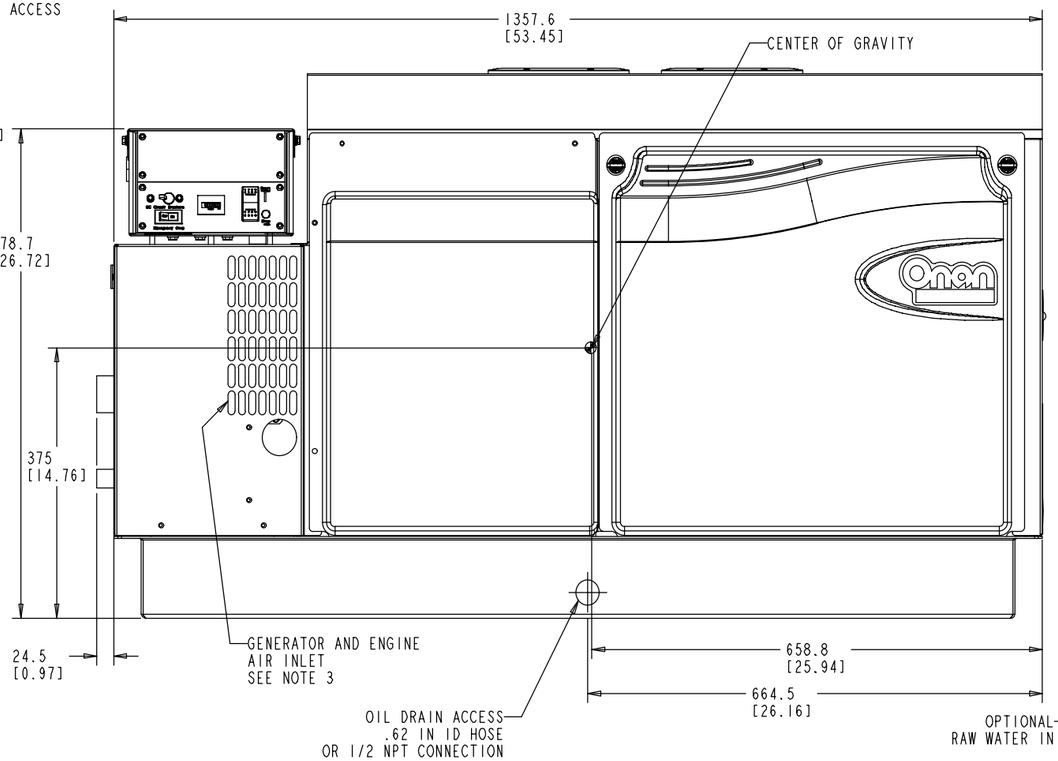


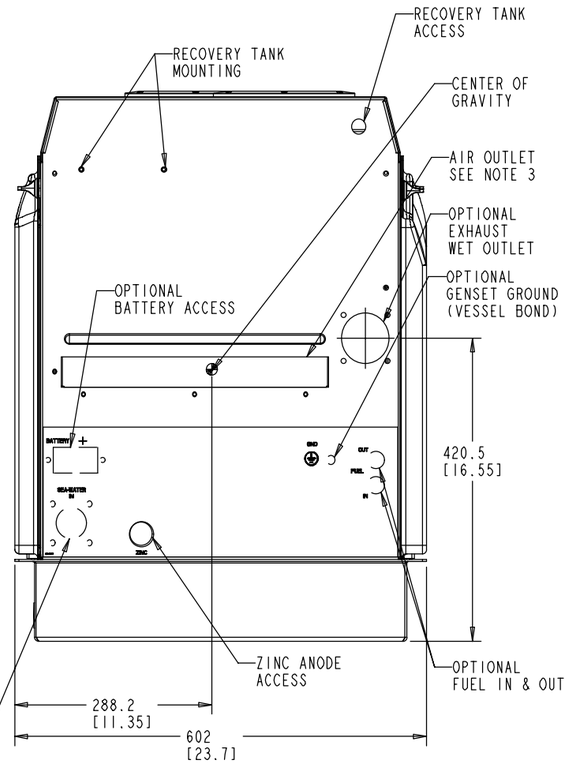
NOTES:

1. DIMENSIONS IN [ ] ARE INCHES.
2. THRU HOLES FOR HOSE ROUTING INCLUDE RUBBER GROMMETS FOR ABRAISON PROTECTION.
3. 100 [4.0] MIN CLEARANCE REQUIRED FOR AIR FLOW AT INLET AND 50 [2.0] AT OUTLET

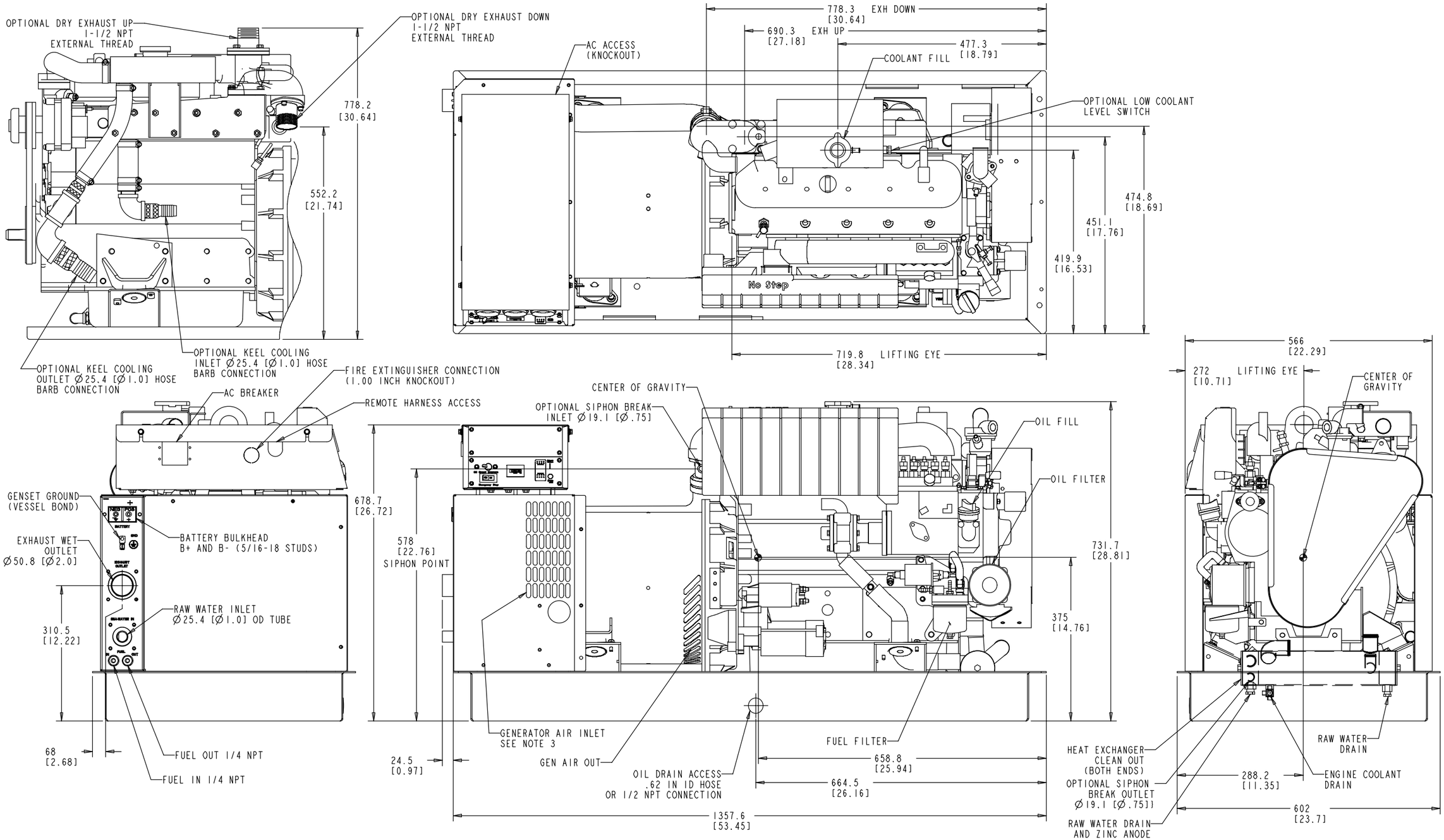
TABULATION		
OPTION	WET WEIGHT	DRY WEIGHT
HOUSED	551KG 1215LB	533KG 1175LB
UNHOUSED	485KG 1070LB	467KG 1030LB



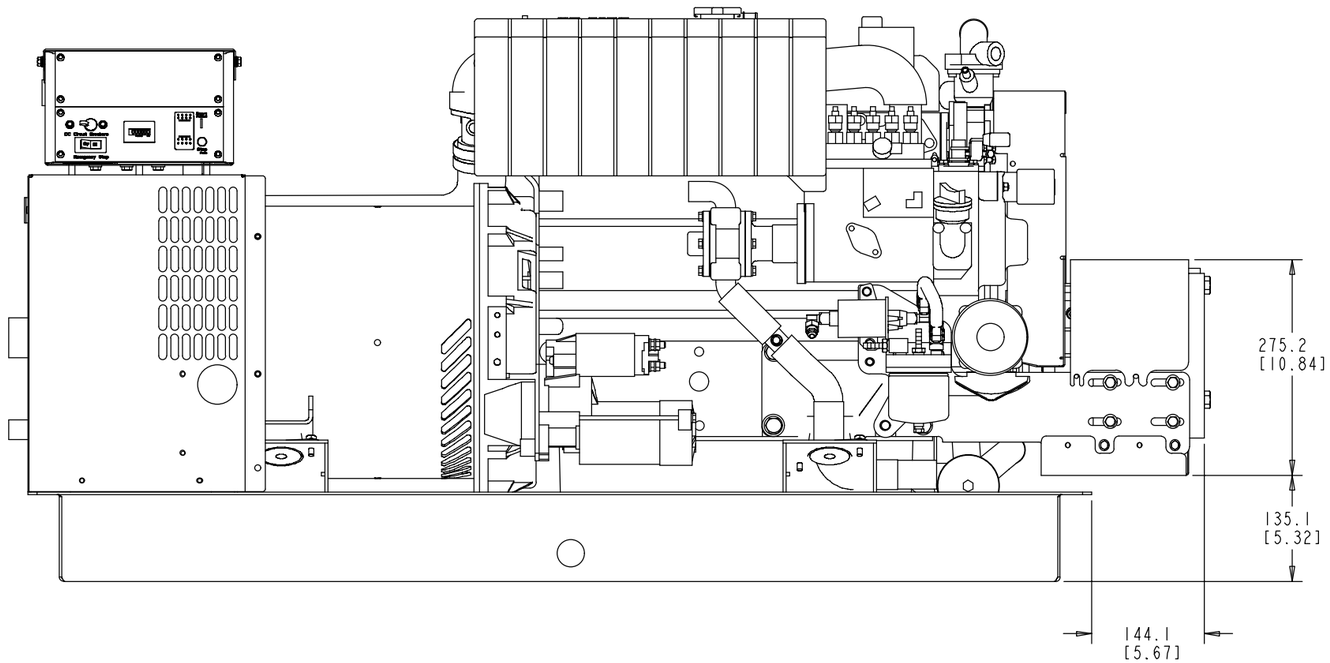


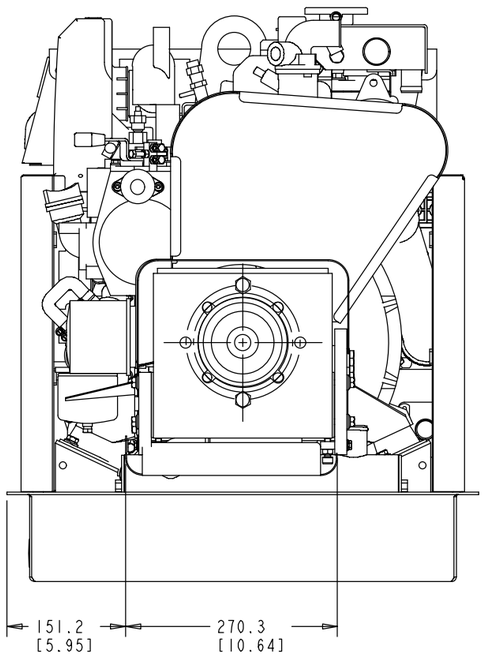


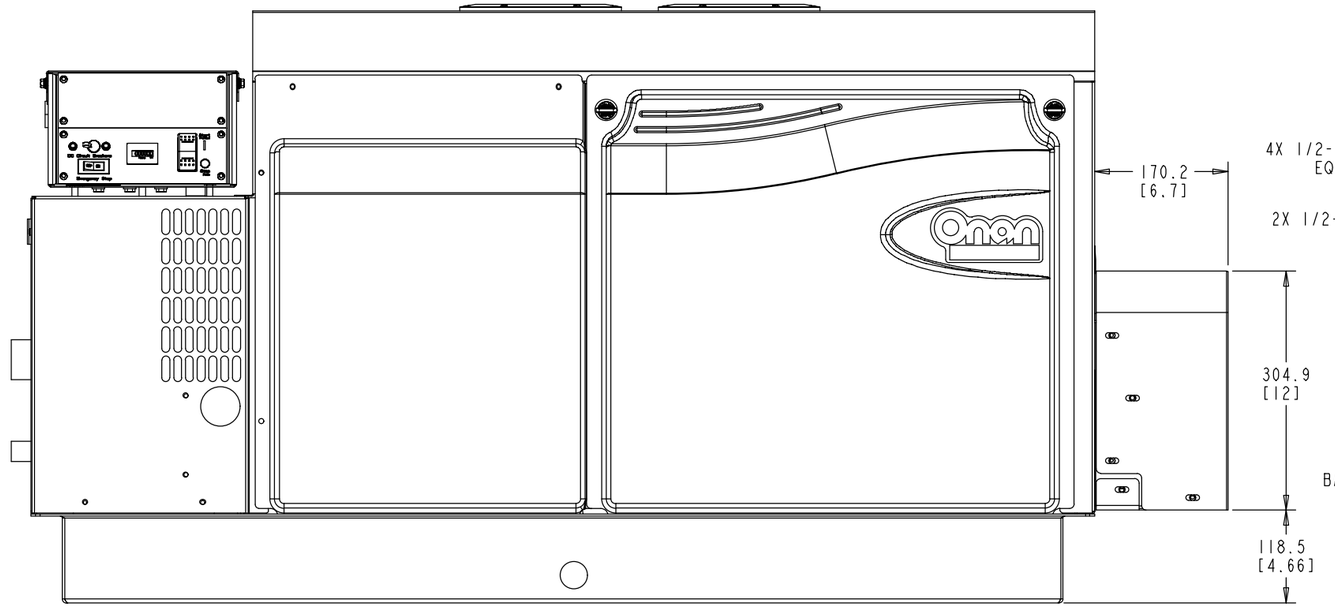
OUTLINE DRAWING—MDKBS (SHEET 1)

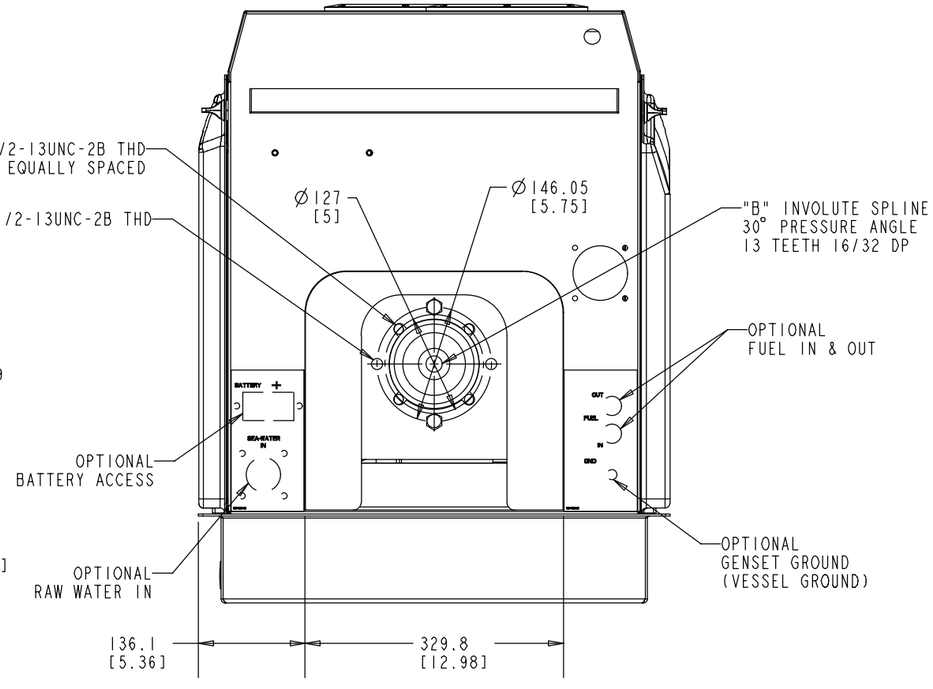


OUTLINE DRAWING—MDKBS (SHEET 2)

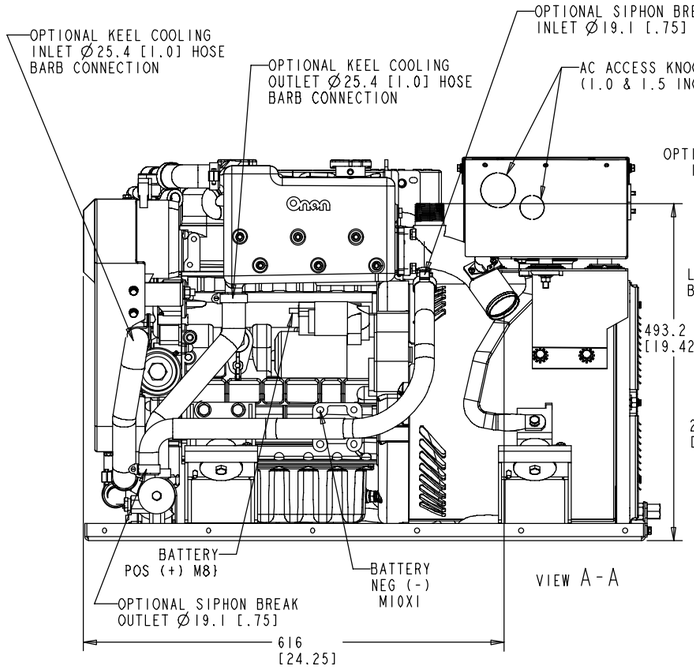


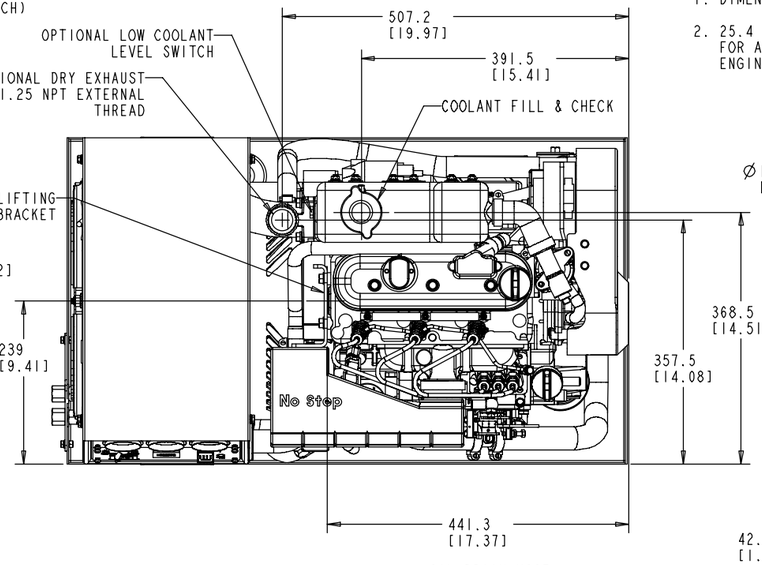






OUTLINE DRAWING—MDKBS (SHEET 3)

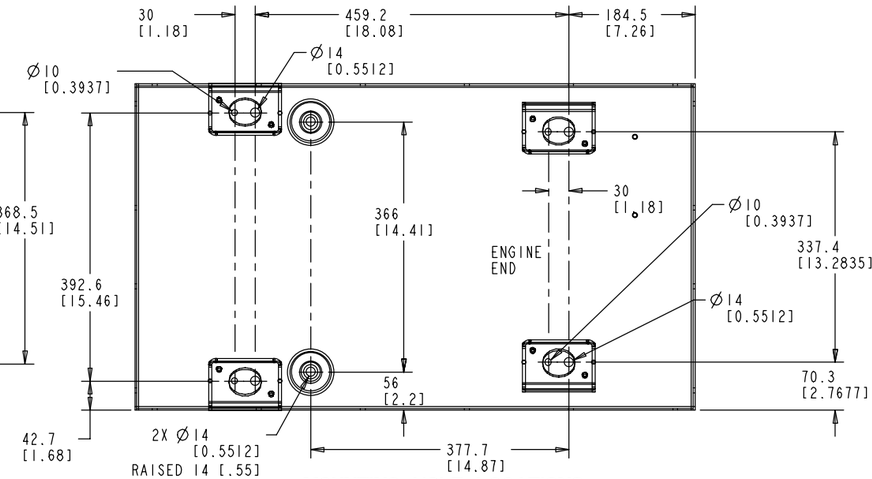

OPTIONAL KEEL COOLING INLET Ø25.4 [1.0] HOSE BARB CONNECTION
OPTIONAL KEEL COOLING OUTLET Ø25.4 [1.0] HOSE BARB CONNECTION
OPTIONAL SIPHON BREAK INLET Ø19.1 [.75]
AC ACCESS KNOCKOUTS (1.0 & 1.5 INCH)
493.2 [19.42]
BATTERY POS (+) M8}
BATTERY NEG (-) M10X1
OPTIONAL SIPHON BREAK OUTLET Ø19.1 [.75]
616 [24.25]
VIEW A-A



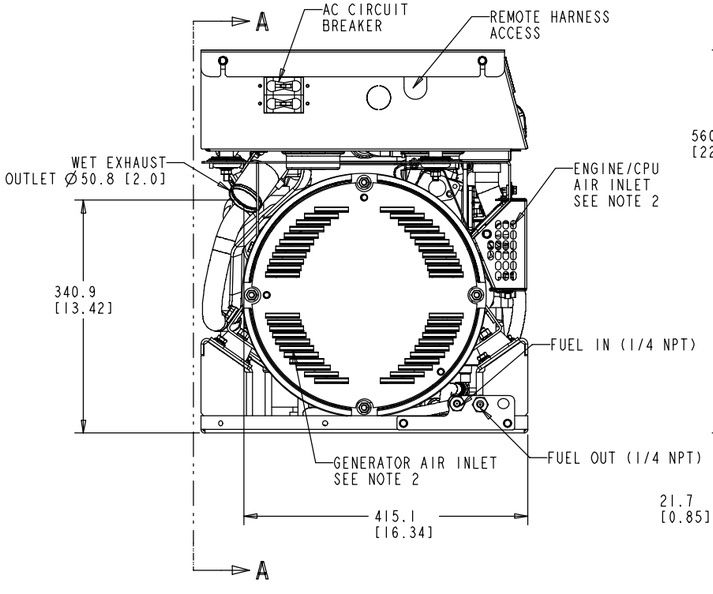
NOTES:

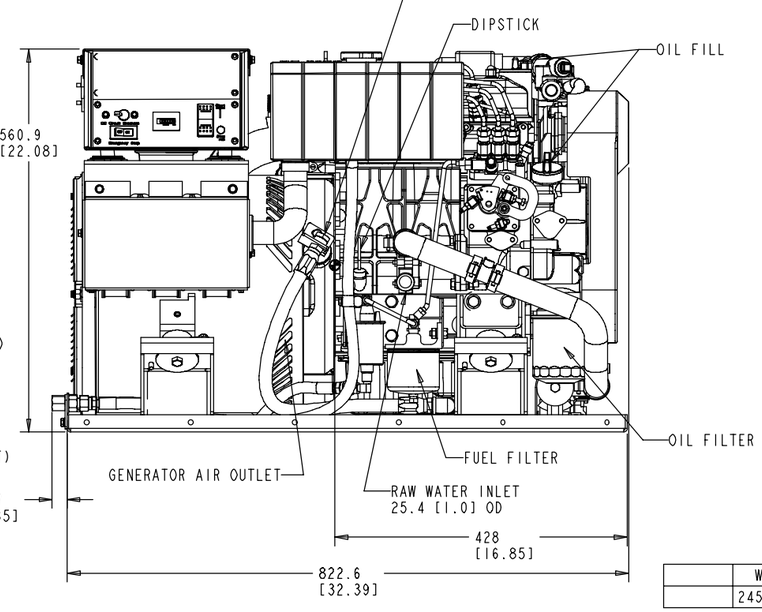
1. DIMENSIONS IN [ ] ARE INCHES

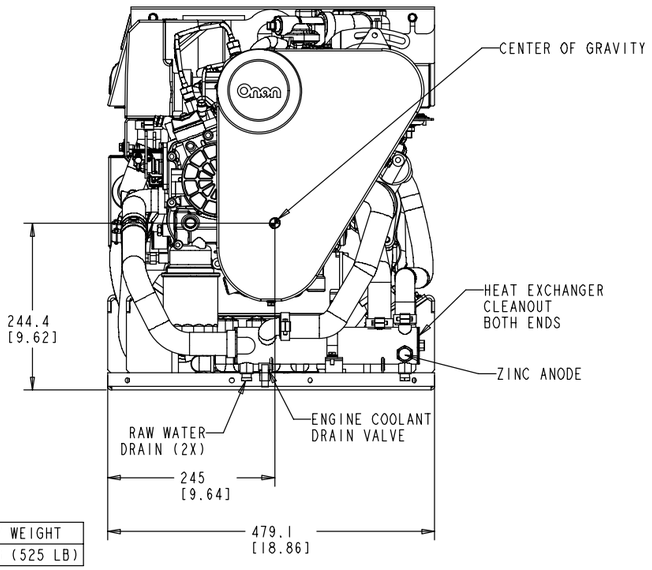
2. 25.4 [1.0] MIN CLEARANCE REQUIRED FOR AIR INLET TO GENERATOR AND ENGINE/CPU



MOUNTING HOLE LOCATIONS VIEWED FORM TOP







	WET WEIGHT	DRY WEIGHT
	245KG (540 LB)	238KG (525 LB)

OUTLINE DRAWING—MDKBK (SHEET 1)